AMERICAN COLLEGE OF OCCUPATIONAL AND ENVIRONMENTAL MEDICINE

Shoulder Disorders

Effective: February 6, 2023

TABLE OF CONTENTS

1. SUMMARY OF RECOMMENDATIONS

The following summary tables contain recommendations for evaluating and managing Shoulder Disorders from the Evidence-Based Shoulder Disorders Panel.

These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
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- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

2. WORKFLOWS

3. INTRODUCTION

3.1. SUMMARY OF RECOMMENDATIONS

Effective: February 6, 2023

The following summary table contains general recommendations for evaluating and managing Shoulder Disorders from the Evidence-Based Shoulder Disorders Panel. See also the recommendations for specific conditions, which are listed in their respective sections:

- Rotator Cuff Tendinopathies
- Bicipital Tendinopathy
- Shoulder Osteoarthrosis
- Shoulder Osteonecrosis
- Adhesive Capsulitis
- Thoracic Outlet Syndrome
- Pectoral Strains and Tears
- Shoulder Dislocations and Instability
- Labral Tears
- Acromioclavicular Sprains and Dislocations
- Shoulder Fractures

- Clavicular Fractures
- Brachial Plexus Injuries
- Trigger Points and Myofascial Pain

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- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

Recommendation	Evidence
Education for Shoulder Disorders	Recommended, Insufficient Evidence (I)
Ergonomic Interventions for Shoulder Disorders	Recommended, Insufficient Evidence (I)
Typing Posture for Prevention of Shoulder Disorders	Not Recommended, Evidence (C)
Typing Posture for Treatment of Shoulder Disorders	Not Recommended, Insufficient Evidence (I)
Keyboarding Breaks for Patients with Shoulder Disorders and for Primary Prevention	Recommended, Insufficient Evidence (I)
Forearm Support for Typing to Prevent Neck/Shoulder Symptoms	Recommended, Insufficient Evidence (I)
Ergonomics Training in Moderate- or High-risk Manufacturing Settings	Recommended, Insufficient Evidence (I)
Ergonomics Training for Prevention of Musculoskeletal Disorders in Office Settings	No Recommendation, Insufficient Evidence (I)
Return-to-work Programs for Treatment of Subacute or Chronic Shoulder Disorders	Recommended, Insufficient Evidence (I)

3.2. OVERVIEW

This clinical practice guideline presents recommendations on assessing and treating adults with shoulder disorders. It is critical to note that "shoulder pain" may often be a symptom of another disorder in another body part, especially of the cervical spine and thorax. Thus, careful evaluation to determine the diagnosis and origin of the pain is critical in order to be able to form a well-founded, evidence-based approach to treatment (see also, e.g., the ACOEM Cervical and Thoracic Spine Disorders Guideline).

This guideline addresses the following shoulder disorders that commonly present to physicians: acromioclavicular arthrosis and glenohumeral arthrosis; acromioclavicular sprain, separation or dislocation; adhesive capsulitis; bicipital tendinitis and tears; brachial plexus injuries; calcific tendinitis; degenerative joint disease (including osteoarthrosis); dislocation (glenohumeral); fractures; instability; labral tear; non-specific shoulder pain; osteonecrosis; rotator cuff syndromes; rotator cuff tears; thoracic outlet syndrome; and trigger points/myofascial pain.

Topics include: the initial assessment and diagnosis of patients with acute, subacute, and chronic shoulder disorders with particular emphasis on work-related factors; identification of red flags that may indicate the presence of a serious underlying medical condition; diagnostic considerations and special studies for identifying clinical pathology; work-relatedness, return-to-work planning (including work restrictions, modified duty, and activity level); clinical management; occupational and physical therapy indications; surgical indications; rehabilitation; and the management of delayed recovery.

Algorithms for patient management are included. The guideline's master algorithm schematizes a recommended approach by which practitioners may generally manage patients with shoulder disorders. The following text, tables, and numbered algorithms expand upon the master algorithm.

Acromioclavicular (AC) Arthrosis, Glenohumeral Arthrosis

Arthroses in the acromioclavicular and glenohumeral joints are common, although less common than those of the hands, knees, and hips. Radiographs show degenerative joint disease and may suggest an underlying etiology. Etiologies for arthroses include osteoarthrosis (also known as osteoarthritis), developmental anomalies, rheumatoid arthritis, other inflammatory rheumatological disorders, crystal diseases, post-infectious complications, and systemic factors. Most cases are assumed to be degenerative osteoarthroses with a genetic component.

Acromioclavicular (AC) Sprain, Separation, Dislocation

Sprains involve high-force falls and any type of trauma that produce a disruption of the ligaments about a joint. Commonly, these injuries occur by direct blow, typically from falling laterally onto the shoulder, or a fall on an outstretched hand, or direct trauma to the joint. AC joint separation ("shoulder separation") and dislocation are more severe than a Grade I AC joint sprain.

Adhesive Capsulitis (Frozen Shoulder)

Adhesive capsulitis[a] involves a reduction in passive range of motion (ROM) of the shoulder in three or more directions. To fully assess, the affected shoulder's ROM should be compared with the unaffected side. Frozen shoulder can be classified as idiopathic adhesive capsulitis, or secondary to trauma, or underlying shoulder pathology. The most common cause is idiopathic and associations with diabetes mellitus, hypothyroidism, and female gender have been reported. Glenohumeral contracture can also occur after traumatic injury, in association with rotator cuff disorders, or after shoulder surgery.

Bicipital Tendinitis and Tears

Anterior shoulder pain may be caused by bicipital tendinitis. Bicipital tears are believed to result from pathophysiological mechanisms similar to rotator cuff tears. Many are thought to be a result of chronic tendinopathy followed by tears while others are a result of an acute traumatic event typically occurring in the context of a prior degenerative tear, which often has been asymptomatic. They generally occur in conjunction with rotator cuff pathology. Another sometimes related but infrequent entity is biceps subluxation and dislocation.

Brachial Plexus Injuries

Brachial plexopathies are caused by forceful stretching or compression of the nerves that travel from the spine to the upper extremity and are thought to occur after relatively severe or high-force accidents, falls from heights, and sports (e.g., “stingers”). However, reliable etiological and epidemiological data are not available. Idiopathic brachial plexopathy occurs infrequently, and Parsonage Turner Syndrome should be considered in the differential diagnosis.

Calcific Tendinitis

There is no consensus as to why calcific tendinitis occurs but some hypotheses include underlying transformation of the tenocytes into chondrocytes inducing subsequent calcification within the tendon; abnormal activity of the thyroid gland; metabolic diseases (e.g., diabetes), and genetic predisposition (993). These calcium deposits are generally found inside or around the rotator cuff tendons, with the supraspinatus tendon being the most common location for such deposition. These patients may either be asymptomatic or have course of clinical onset that is similar to adhesive capsulitis in those with chronic non-severe pain. It can also present as acute severe onset of atraumatic shoulder pain, an unusual presentation for rotator cuff syndromes. The risk factors, evaluation, diagnosis, and some treatments tend to be similar to rotator cuff tendinopathies although there are some specific differences.

Degenerative Joint Disease (including Osteoarthrosis)

Degenerative joint disease is a term which includes any age-related changes in any joint from any cause. Joints in the body are typically synovial fluid-filled, synovium-lined, ligamentously encapsulated joints that allow for low friction movement between adjacent bones. Common causes are osteoarthrosis, inflammatory disorders (e.g., rheumatoid arthritis, systemic lupus erythematosus, and psoriasis) and crystalline arthropathies (e.g., gout, pseudogout, apatites). Osteoarthrosis (OA) is the more precise name for osteoarthritis, as there is no overt inflammation with redness, swelling, or palpable warmth. OA, a degenerative disorder in the joint which primarily affects the cartilage on the articular surface, is marked by thinning of that cartilage, osteophyte formation, and subchondral sclerosis. Pain on movement and stiffness develop. Post-traumatic OA may develop in a joint after a significant injury (e.g., fracture), in which case it is often delayed by many years. If there is asymmetric disease in the shoulders on x-ray and this injury was occupational, then the subsequent osteoarthrosis is also typically considered, at least in part, occupational. As inflammatory and crystalline arthropathies are non-occupational, they are not included in detail in this guideline.

Dislocation (Glenohumeral)

Shoulder dislocation occurs when a supramaximal force is applied to the shoulder musculature and joint capsule, which definitionally are unable to resist, resulting in stretching and partial rupture of the joint capsule. Labral tearing also usually accompanies this injury. As this injury involves disrupting ligaments, it is technically a sprain. Frequently, the shoulder will require a closed reduction by a medical professional, although sometimes the patient accomplishes this prior to seeking medical care. Once dislocated, the shoulder ligaments will become more lax, generating more instability and potentially causing recurrent dislocations. Older patients with dislocations frequently have associated rotator cuff tears and fractures.

Fractures

Fractures occur due to high-force trauma including falls, sports, and motor vehicle accidents. Pathologic fractures are the primary exception as minimal force may be required for those fractures.

Instability

Shoulder instability is associated with a tendency to sublux or dislocate the shoulder. Instability is a frequent sequela of dislocation. It can also occur due to developmental abnormalities. Instability can be classified as traumatic, atraumatic instability, or multi-directional instability.

Labral Tear

The labrum is a wedge-shaped fibrocartilaginous structure at the rim of the glenoid that is a transitional tissue from the articular cartilage of the glenoid to the capsuloligamentous tissue/structures of the glenohumeral joint. The two commonly reported types of tears are along the superior labrum (SLAP) and the anterior inferior portion (Bankart), although the labrum may tear at any point. The long head of the biceps attaches to the superior labrum, and therefore biceps pathology may coexist with superior labral tears. The labrum is intimately involved in mechanisms of shoulder stability. The labrum is susceptible to age-related degeneration and acute injuries can occur superimposed on these degenerative processes. A labral tear may be associated with shoulder instability or dislocation.

Non-Specific Shoulder Pain

Some cases of shoulder pain do not clearly fit diagnostic criteria and are considered non-specific. These cases most commonly resolve prior to identifying a clear diagnosis, but otherwise a specific diagnosis usually becomes clear with time.

Osteonecrosis

Osteonecrosis (avascular necrosis) is particularly likely to occur in areas of tenuous blood supply that lack collateral blood flow. The hip joint is most commonly affected, followed by the humeral head. It can progress to degeneration and ultimately humeral head collapse. Reported risk factors for osteonecrosis in any region of the body include male sex (994), diabetes mellitus, glucocorticosteroid treatment or excess (994), sickle cell anemia or trait, alcohol, organ transplantation (995), and multiple myeloma (994). The most prominent occupational risk factors are proximal humeral fractures and barotrauma (“the bends”), which may occur both in underwater diving, as well as working in compressed air environments (e.g., certain types of tunneling projects through unstable sediments requiring compressed air to maintain the workspace).

Rotator Cuff Disorders

(Includes rotator cuff tendinopathies, rotator cuff tendinosis/tendinitis, supraspinatus tendinosis/tendinitis, rotator cuff partial tears, impingement syndrome, bursitis)

In general, rotator cuff-related tendinopathy and related disorders such as rotator cuff partial tears, impingement syndrome, and bursitis, can be considered the same degenerative condition (996,997,998,999,1000,1001,1002,1003,1004,1005,1006,484,1007,1008,535,1009,1010,1011,1012). There has long been evidence of insufficient blood supply in the typical area(s) of rupture (1013,1014,1015,1016,1017,1018) and recent evidence points to numerous atherosclerotic disease

risk factors (423,1019,251,252,253,416,866,417,418,419,421,1020) strongly suggesting a pathophysiological mechanism of atherosclerosis and/or small vessel disease of the arterial supply to the tendons.[b] The other primary competing theory, first described in the 1920s by Meyer (1021,1022,1023) and advanced by Neer (1008,1024), is biomechanical, particularly with impingement of the acromion that develops as a consequence of the age-related degenerative processes (1025,1026,1027,1028,928,126). Both theories may play a role, although the atherosclerotic vascular supply mechanism has the largest statistical associations and so appears of primary importance (423,250,1029). Patients with tendon pathology often have shoulder pain that radiates to the upper arm and deltoid region, and some even report more distal radiation without paresthesias. Bursitis tends to have non-radiating shoulder joint pain, although it too may present with deltoid region pain. Partial-thickness tears cannot reliably be clinically distinguished from the other rotator cuff entities. Many of the symptoms and examination maneuvers used to assign a diagnosis of "rotator cuff syndrome" are not specific to a cause. The supraspinatus tendon is the most commonly affected tendon in the rotator cuff. Tendon pathology most commonly progresses posteriorly to the infraspinatus. Tendinopathies are generally considered the most important of the occupational shoulder disorders based on high prevalence (1030,1031).

Rotator Cuff Tears

(including supraspinatus, other full-thickness tears and bicipital tears)

Rotator cuff tears appear to occur over years of degenerative rotator cuff tendinopathy, culminating in a full-thickness rotator cuff tear. Presentations vary from severe symptoms to asymptomatic, despite presence of a tear (1032). It is not clear if, or to what extent, tears are caused by trauma. Most rotator cuff tears develop at the anterior aspect of the midsubstance of the supraspinatus tendon and progress in all directions, but especially posteriorly to eventually involve tears of the infraspinatus and teres minor. Involvement of the subscapularis is less common, but should be considered. The prevalence of rotator cuff tears is 6-51% for full-thickness tears in asymptomatic patients over age 50 (998,999,1002,1005,252,416,1024,1025,1026,1031,1033,1034,1035,1036,1037,1038,1039,1040,1041,1042,1043,1044,1045).

Thoracic Outlet Syndrome

Thoracic outlet syndrome (TOS) involves compression of the neurological and/or vascular supply to the upper extremity. A few cases involve discrete compression by the first thoracic rib or cervical rib. Scalene muscle tightness has been described as a cause. There are other causes of what could be termed physiologic TOS however, there is controversy regarding whether there is true compression of structures.

Trigger Points/Myofascial Pain, Muscle Tension Syndrome

Myofascial pain syndrome involves trigger points, which are tender areas that may feel dense with palpation and can elicit pain locally and distally. Patients with muscle tenderness are typically diagnosed with "myofascial pain." Prolonged muscular pain is often linked to underlying psychosocial issues and affective disorders are common. Physical inactivity is common and there is a propensity towards dependence on passive modalities and pharmacologic interventions. Most randomized control trials (RCTs) have not distinguished between tender points (typically found with fibromyalgia; see the Chronic Pain Guideline) and trigger points, though they frequently note pain limited to muscles of a body region. However, trigger points have been distinguished by some practitioners from tender points in that trigger points can "give rise to characteristic referred pain, referred tenderness, motor

dysfunction, and autonomic phenomena [such as muscle twitching or spasm]," and tender points do not (1046).

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[a] Nomenclature has long been problematic and the term *periarthritis* has also been used (1047,1048).

[b] This does not rule out contributing mechanical factor(s).

3.2.1. IMPACT

Shoulder disorders are the fourth most common reason patients seek health care treatment for musculoskeletal pain (1049,1050,1051,1052,1053,1054,1055,58). These disorders are also among the five most common causes of reported work-related musculoskeletal disorders (MSDs) in workers' compensation claims in the United States (1056,1057,1058,1059). In 2000, annual health care costs for shoulder pain in the United States have been estimated at more than $7 billion (1060). Arm/shoulder disorders in 2016-17 cost an average of $24,736 in medical costs and $20,729 in indemnity for a total of $45,465 per worker's compensation case (1061). Musculoskeletal shoulder disorders account for approximately 3–5% of total lost workdays and 10–18% of claims and costs in workers' compensation, ranking them in the top five for financial severity (1056,1062,1063). Workers' compensation status is associated with higher costs, worse prognosis, and worse outcomes than patients without workers' compensation status or involving litigation (1064,1065,1066,1067,1068,1069,1070). In general, shoulder disorders are prone to recur (866,1071,438,1072,1073,1074,1075) and are often associated with actual or perceived worse general health status (250,1020,1076,1077,1078,1079,1080).

3.3. BASIC PRINCIPLES AND DEFINITIONS

Acute, Subacute, or Chronic Pain: For purposes of identifying interventions at different stages of diseases, acute pain is defined as pain for up to 1 month; subacute is pain from 1 to 3 months; and chronic is pain lasting more than 3 months duration (see Chronic Pain Guideline for additional information).

Active Therapy: The term "active therapy" is commonly used to describe treatment that requires the patient to assume an active role in rehabilitative treatment. Although there is no one specific treatment defined by this term, it most commonly includes therapeutic exercises (particularly aerobic), functional activities, and muscle reconditioning (weightlifting or resistance training) (1). Some studies have included active stretching and treatment with psychological, social, and/or educational components requiring active participation from the patient (2).

Active Exercise Therapy: Active exercise therapy typically consists of cardiovascular training and muscle strengthening, (3,4) although it may also include progressive or occasionally active stretching, especially in patients with substantially reduced ranges of motion. Active exercise therapy is used as a primary treatment for chronic pain and after various surgeries. It is also frequently initiated in the course of treating subacute pain. The goal of active exercise therapy is to improve and/or restore function (3). The word "active" is used to differentiate individualized exercise programs designed to address and rehabilitate specific functional, anatomic, or physiologic deficits from passive treatment modalities or from forms of "exercise" that require little effort or investment on the part of the patient or provider.

Brachial Plexus: The nerves traveling from the C5 to T1 spinal cord levels' ventral rami to the upper extremity in aggregate are termed the brachial plexus. This includes subdivisions of these nerves that are anatomically labeled roots, trunks, divisions, cords, and branches. The anatomic region of the

plexus extends from the tissue adjacent to the spinal cord to the axilla. Injuries to these structures are frequently termed brachial plexopathy.

Bursae: Bursae are thin, lubricated, fluid-filled sacs located between bone and surrounding soft tissue, bones and tendons, and/or muscles around joints that reduce friction as movement occurs.

Bursitis: Bursitis is inflammation of a bursa and may be marked by pain when the proximate tissue is used or the bursa is compressed.

Delayed Recovery: Delayed recovery is an increase beyond the expected time prior to returning to work or to usual activities, based on reasonable expectations, disorder severity, age, and treatments provided.

Functional Capacity Evaluation (FCE): A comprehensive battery of performance-based tests used to attempt to assess an individual's ability for work and activities of daily living (5). A job-specific FCE may be done to attempt to identify an evaluee's ability to perform specific job tasks associated with a job while a general FCE may be done to attempt to identify an evaluee's ability to perform physical activities associated with any job. Results should be interpreted with caution, as validity is unproven. The testing should be preferably conducted by someone well-experienced in dealing with patients who may self-limit due to pain (e.g., occupational or physical therapist).

Functional Improvement (especially objective evidence): Functional improvement entails tracking and recording evidence of making progress toward increasing a patient's functional state. This is best measured by objective evidence such as returning to work and/or lessening of work limitations. Additionally, use of validated tools such as QuickDASH is often helpful and preferred to non-validated tools.

Functional Restoration: Functional restoration (sometimes referred to as "interdisciplinary rehabilitation with a focus on improving function") often refers to a blend of various techniques and programs (both physical and psychosocial), rather than one specific set of active exercises, processes, or therapies. The basic principle for all of these individually tailored programs is to help patients cope with pain and return to the functional status required for their daily needs and work activities (6). The term "Functional Restoration Program" frequently refers to a full-day multidisciplinary, medically-directed program typically lasting from 3 to 6 weeks, employing an interdisciplinary team often consisting of therapists, psychologists, case managers, and nurses (7).

Pain Behavior: Pain behavior includes verbal and non-verbal actions (e.g., grimacing, groaning, limping, using pain relieving or support devices/slings, requesting pain medications, etc.) which communicate the concept of pain.

Passive Modality: Passive modality refers to various types of provider-given treatments in which the patient is not an active participant. These treatments include medication, injection, surgery, allied health therapies (e.g., massage, acupuncture, and manipulation), and various physical modalities such as hydrotherapy (e.g., whirlpools, hot tubs, spas, etc.), ultrasound, TENS, other electrical therapies, heat, and cryotherapies.

Rehabilitation: The term "rehabilitation" is used in these *Guidelines* to mean physical medicine, therapeutic and rehabilitative evaluations, and procedures. Rehabilitation services are delivered under the direction of trained licensed individuals such as physicians, occupational therapists, or physical therapists. Mental health professionals may also be incorporated in the treatment team, particularly for select chronic pain patients.

Shoulder Impingement: Shoulder impingement is a theoretical construct advanced especially over the past 40 years, proposing that the supraspinatus tendon is compressed between the acromion and humeral head, resulting in pain, degenerative tendinopathy, and tears.

Shoulder Joint: The shoulder (glenohumeral) joint is a shallow synovial ball-and-socket joint based on the articulation of the head of the humeral head and glenoid fossa of the scapula. The supraspinatus,

infraspinatus, teres minor, and subscapularis muscles and their tendons comprise the rotator cuff and contribute to attachment and movement of the humeral head in the glenoid fossa.

Tendinitis: Tendinitis is inflammation within the tendon or tendon insertion with the clinical signs of redness, heat, and swelling, accompanied by pain and decreased range of movement. While "tendinitis" is a widely used term for many cases of shoulder pain diagnostically, most patients do not demonstrate cardinal signs of inflammation and more typically may have serological markers of low-grade inflammation.

Tendinosis: Tendinosis is a chronic degenerative tendon injury, unaccompanied by redness or heat. It is associated with pain and limited movement (8). Tendinosis may be due to an interaction of individual and physical factors (especially cardiovascular disease risk factors), which may include vocational and avocational activities. Previously, there was a theory of "micro-injuries" that was widely used; that theory has been largely discarded as the accumulated evidence is increasingly demonstrating atherosclerotic changes in the small vessels supplying tendons with already poor blood supplies.

Sprain: A sprain is the disruption of a ligament and is caused by high forces that exceed ligament tolerances. Sprains are typically graded I-III, ranging from modest ligamentous tears but no laxity (I) to complete disruption of the ligament (III).

Strain: Strain is the disruption of a myotendinous junction or a muscle, usually from a high-force unaccustomed exertion. It may also occur during an accident. This term is occasionally used to describe non-specific muscle pain in the absence of knowledge of an anatomic pathophysiological correlate.

- Grade I: overstretching or slight tearing.
- Grade II: incomplete tearing.
- Grade III: complete tear or rupture.

3.4. INITIAL ASSESSMENT

Thorough medical and work histories and a focused physical examination (see General Approach to Initial Assessment and Documentation) are sufficient for the initial assessment of most workers with potentially work-related shoulder symptoms. The medical history and physical examination include evaluations for serious underlying conditions, red flags, and consideration for possible referred shoulder pain due to a disorder in another part of the body (most commonly from the cervical spine and sometimes viscera). The absence of red flags largely rules out the need for special studies, referral, or inpatient care during the first 4 to 6 weeks for most patients, during which spontaneous recovery is typically expected. Shoulder disorders may be classified into one of three somewhat arbitrary categories:

- **Potentially serious conditions:** including fractures, glenohumeral dislocation, infection, or neurological or circulatory conditions, including referred cervical, cardiac, or intra-abdominal pain. Glenohumeral dislocations are considered potentially serious until it is confirmed there is not concomitant fracture or nerve damage.
- **Specific shoulder disorders:** including full-thickness rotator cuff tears, rotator cuff tendinopathies/syndromes (impingement syndrome, rotator cuff tendinosis, rotator cuff tendinopathy, supraspinatus tendinosis, partial-thickness rotator cuff tears, bursitis), bicipital tendinosis, acromioclavicular (AC) joint sprain or separation, labral tears, thoracic outlet syndrome (TOS), brachial plexus injury, adhesive capsulitis (frozen shoulder), calcific tendinitis, and instability.
- **Nonspecific shoulder disorders:** suggesting neither internal derangement nor referred pain including trigger points/myofascial pain (including muscle tension syndrome), fibromyalgia

(see Chronic Pain Guideline), degenerative joint disease (including osteoarthrosis), and nonspecific pain.

3.5. MEDICAL HISTORY

The initial evaluation of patients with shoulder pain should include a thorough medical history, as the vast majority of data to successfully evaluate and treat these patients is found in the history. A complete occupational history is necessary to assist the patient with successful accommodation and rehabilitation, as well as to determine work-relatedness (see General Approach to Initial Assessment and Documentation Guideline; see Work-relatedness Guideline). Standardized questionnaires assessing functional loss and disability, often called functional patient-reported outcome measures (fPROMS), are recommended to routinely measure shoulder function and disability in clinical practice (e.g., Disability of the Arm, Shoulder and Hand (DASH) questionnaire, Shoulder Pain and Disability Index (SPADI) questionnaire) (9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31).

3.5.1. MEDICAL HISTORY QUESTIONNAIRE

Download a PDF version of the Shoulder Disorders Medical History Questionnaire here.

Asking the patient open-ended questions, such as those listed below, allows the physician to gauge the need for further discussion or specific inquiries to obtain more detailed information. Start eliciting a history with open-ended questions, such as: “What may I do for you today?” This approach helps to frame the discussion towards what the patient feels is the main purpose of the visit. Elicitation of the patient’s concerns may initially include seemingly tangential issues, but may prove important later and helps ensure that the physician is able to address issues important to quality clinical care and patient experience.

1. SYMPTOM ONSET

- What are your symptoms?
- When did your symptoms begin?
- Where did your symptoms first occur? Were there symptoms primarily in the shoulder joint, down the arm, hand, and/or up in the neck?
- What do you think caused the problem? How did it occur? Do you recall a specific inciting event?
- How do you think it is related to work? (It is important to obtain all information necessary to document the circumstances and biomechanical factors of injury to assist the patient in obtaining compensation, where appropriate.)
- Was there acute or gradual onset of pain or limitation of motion? For traumatic injuries: was the area deformed?
- What is the day pattern to your pain? When is it worst? Do you have a problem sleeping?
- How does having this pain affect your life?

2. PROGRESS OF SHOULDER CONDITION

- Since these symptoms began, have your symptoms changed? How?
- Have your activities been limited? How long have your activities of daily living been limited? For how long?
- What tests or imaging have you had?
- Have you had specialist consultations?

- What treatments have you had so far, including over-the-counter and prescription medication?

3. PRESENT SYMPTOMS

- What are your symptoms currently? How does the worker act when describing them (may help to ascertain the expression of and meaning of pain to the worker, while simple hand gestures and postures taken while describing the pain are often highly useful for diagnosis)?
- Are you experiencing pain, weakness, or limited motion (stiffness) in your shoulder?
- Are you experiencing popping, clicking, or catching in your shoulder?
- Does your shoulder feel unstable?
- Are your symptoms currently located primarily in the shoulder joint?
- Is your shoulder pain associated with pain, numbness, tingling, swelling, or color change in the hand or arm?
- Are your symptoms constant or intermittent?
- What makes the problem worse or better?
- Do you have pain or other symptoms elsewhere (e.g., neck, chest, or abdomen)? Do you have fever, night sweats, or weight loss?

4. PRESENT SHOULDER CAPABILITIES

- Can you move your arm over your head?
- Can you tuck in your shirt, reach your back pocket, or put on a jacket?
- Can you do overhead activities or work? For how long?
- Can you wash your hair?
- How much weight can you lift? What could you lift before?
- Can you move your shoulder without pain?
- Can you sleep on the affected shoulder?
- Does wearing a bra, suspenders, or tool belt harness make your shoulder pain worse or cause pain?
- How heavy is your purse/shoulder bag? Have you changed purses/bag (lightened) or changed how you carry it (to the other shoulder or rolling bag)?
- Do you have weakness in your hand, arm, or shoulder?
- Have you noticed any loss of muscle mass?

5. PATIENT GOALS

- What are your goals in relation to this shoulder problem?
- What are you currently unable to do that you want to be able to get back to?
- What are your goals for work? Non-work activities? Hobbies? Sports?
- What could we measure as goals to track your progress?

6. PREVIOUS SHOULDER PROBLEMS

- Have you had similar episodes previously?
- Have you had previous testing or treatment? What treatment (medication, surgery, therapy, etc.)? What were the results? With whom?
- How was your recovery?
- Did this previous shoulder problem resolve completely?
- How long did it take to get back to light duty work? To full duty work?

- If didn't return back to original occupation: were you determined to have a disability?

7. JOB REQUIREMENTS

- What are your specific job duties? Do you rotate jobs?
- What does your work require you to do with your shoulder?
- What postures and activities are required at work? How much do you lift at work as a maximum lift? How heavy is a usual lift? Do you work with your hands at or above chest height?
- Do you have assistance of other people or lifting devices?
- How often are shoulder activities required?

8. OFF-THE-JOB ACTIVITIES (AVOCATIONAL ACTIVITIES)

- What other activities (hobbies, workouts, sports) do you engage in at home or elsewhere (outside of work)?
- Do you use your shoulder to perform these activities?
- Do you do any overhead arm actions? How? How often?
- Can you perform activities of daily living (e.g., dressing, bathing, grooming, etc.) or instrumental activities of daily living (e.g., shopping, food preparation, housekeeping, etc.)?

9. DO YOU HAVE OTHER MEDICAL PROBLEMS?

- Osteoarthrosis, rheumatoid arthritis or other arthritides or auto-immune disorders (e.g., lupus, psoriasis)?
- Fractures, upper extremity surgeries?
- Cardiovascular disease? Heart disease risk factors?
- Pulmonary disease? Do you smoke? Did you smoke? How much?
- Gastrointestinal problems or liver disorder?
- Diabetes mellitus? Thyroid disorder?
- Do you have neck pain or history of neck trauma?
- Neurological disorders (including neuropathies, radiculopathies, headaches)?
- Psychophysiological disorders (e.g., irritable bowel syndrome, chronic fatigue syndrome, sick building syndrome, fibromyalgia, or multiple chemical sensitivities)?
- Do you have symptoms of infection? Fever, chills, symptoms of infection elsewhere?
- Have you ever had cancer?
- What medications do you take? Over-the-counter medications? Prescription medications?

10. Is there any psychological, psychiatric, mental health, substance use, or alcohol history?

- Have you ever had a substance use problem? Driving while under the influence of alcohol? Detoxification?
- Have you ever had an alcohol problem? (CAGE or MAST screening especially required for possible osteonecrosis)
- Is there use of other drugs? (Current and prior use)

11. What is the occupational psychosocial context?

- Do you like your job?
- What is your relationship with your co-workers and supervisor and how do they treat you?

12. Assess whether there are problems at home/social life. Does the patient feel in control of most situations? Is there support?

- How do your family members get along with each other?
- How do they help and support you, including assistance with chores?
- Does your family treat you differently now that you are in pain? Have your roles at home changed because of your injury?
- How do your friends treat you differently?
- Do you get increased symptoms when you are dealing with problems with your family and friends? How often? When? Why?

13. As billing is different, and rules regarding treatment often differ, it is important to know if there is worker's compensation, or other compensation? Are there advocagenic[a] (litigious) influences?

- Do you have a lawsuit or other legal action involving this pain problem?

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[a] The term advocagenic is analogous to iatrogenic, however, it is related to influences involving the litigation processes with examples including: compensation dependent on symptom severity and duration, advice to limit functional activity, work-limitation advice that conflicts with medical opinion, advice contrary to medical plan, and symptom recurrence/exacerbation after contact with an attorney (32).

3.6. PHYSICAL EXAMINATION

The objective of the physical examination of the shoulder is to define physical abnormalities, narrow the diagnostic considerations, and focus the treatment plan (33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53). Physical examination data, including vital signs, should be reviewed for potential inferences regarding infectious or neoplastic origins.

The physical examination should begin the moment the physician sees the patient. Observing how the patient holds the shoulder (particularly during a history), uses the shoulder, sits, walks, and moves is of major importance, often more important than any other aspect of the exam. It also helps to have the patient demonstrate what positions seem to provoke or cause the symptoms, as the demonstration is invariably of greater help than verbal descriptions.

Guided by the medical history, the physical examination includes:

- General observation of the patient;
- General level of fitness and physical condition;
- Upper quadrant screen for neck involvement, and other upper extremity disorders, including elbow;
- Neurovascular screening;
- Testing for various specific shoulder disorders as appropriate to the history; and
- Monitoring for pain behavior during range of motion, changing postures as a clue to origin of the problem.

3.6.1. REGIONAL SHOULDER EXAMINATION

The entire shoulder girdle should be visible and viewed from all angles. Asking the patient to point to the area of discomfort may be helpful for discrete entities such as AC joint or long head biceps pathology. Pointing helps determine if the discomfort is at the shoulder joint or if the patient is referring to the "shoulder" in general (e.g., the upper trapezius). Many shoulder disorders present with pain that is too diffuse to point to with one finger.

Observe asymmetry or deformity at rest and during movement. Atrophy of the deltoid or scapular muscles is an objective finding, only arising after weeks to months of symptoms; atrophy of the supraspinatus muscle is the most clinically relevant. Deformities due to acromioclavicular separation are visible (e.g., scapular winging at rest, shoulder girdle ptosis), as are many signs of infection (e.g., elevated temperature, redness, heat, fluctuance) or gross tumor (e.g., visible vessels, palpable mass). Palpate neck, shoulder and arm structures, noting patient's underlying tenderness.

Shoulder range of motion (ROM) should be determined actively and passively. Active ROM should be performed first to determine how far the patient can move prior to applying pressure to assess passive ROM. Essential active motions to assess are shoulder elevation in flexion and abduction, external rotation, and internal rotation with the arm at the side and at 90° of abduction (1080). Passive ROM should be performed for the same motions. Passive motion is best assessed with the patient supine. The examiner may also determine passive ROM by eliminating gravity with overpressure, having the patient in the pendulum position, or by having the patient use the other arm to aid elevation. While checking ROM, watch for scapular mobility and stability. Movement of the scapula should be observed for winging or dysrhythmia during active elevation in flexion and/or abduction (1081,1082). Both can be enhanced by fatiguing the shoulder with repeated active range of elevation and lowering the arm. Strength should be assessed, resisting isometric contractions of the same essential motions for ROM described above, including supraspinatus and infraspinatus assessment.

The choice of which specific tests to use (see Table 1) may be guided by the synthesis of the information obtained from the history and physical examination. However, many examination maneuvers have not been validated in quality clinical trials, and do not have well established sensitivities and specificities. Many exam maneuvers are also reportedly non-specific and of questionable value (866,58,54,1083,670,1084,1085,1086,1087,96). It is important to correlate data from history (e.g., demographics, type and location of symptoms, mechanism of injury) with findings on physical examination. For example, findings of instability maneuvers are irrelevant if instability is not the problem. If certain shoulder problems (e.g., pain) are sufficiently severe, other diagnostic tests may not be helpful; for example, in the presence of substantial joint stiffness and capsulitis, impingement maneuvers are invalid.

3.6.2. NEUROLOGIC AND VASCULAR SCREENING

C5 or C6 radiculopathy may present as shoulder pain or dysfunction. Soft tissue disorders of the neck can also present as shoulder pain. Examine the neck and cervical nerve root function with palpation, reflexes, strength (motor), and sensitivity to touch (sensory), guided by history and previous exam findings. Assess the vascular status of the shoulder, proximal upper extremity, and neck by checking peripheral pulses in neutral and stress positions, and edema and/or color changes. Thoracic outlet syndrome (TOS) has varying signs and symptoms depending on whether it is primarily arteriol, venous, or neurogenic. Symptoms may include scalene tenderness and positive maneuvers that provoke neurovascular signs and symptoms; for example, Hofmann-Tinel's sign may be positive over the brachial plexus. Once all other diagnoses have been ruled out and TOS is suspected, non-operative

measures should generally be attempted; referral to a surgeon is recommended for those individuals with confirmed vascular TOS or those with neurogenic TOS who have failed to improve with 3-6 months of conservative management.

3.6.3. ASSESSING RED FLAGS

Physical examination evidence of septic arthritis, neurologic compromise, cardiac disease, or intra-abdominal pathology that correlates with the medical history and test results may indicate a need for immediate consultation depending on the physician's skills and abilities. Consultation may further reinforce or reduce suspicions of tumor, infection, fracture, or dislocation. A medical history that suggests pathology originating in a part of the body other than the shoulder might warrant examining the cardiovascular and respiratory systems, abdomen, or other areas. Painless full ROM of the shoulder suggests referred pain.

3.7. DIAGNOSTIC CRITERIA

The cause of the patient's shoulder symptoms should be determined as accurately as clinically possible at the time the patient presents. Some imaging may be appropriate acutely – e.g., x-ray in trauma cases and other conditions outlined in the Special Studies section below. Consensus recommendations for imaging can be found on the American College of Radiology Appropriateness Criteria website. If red flags are present, enact or arrange definitive care or treatment. If no red flags for serious conditions are present, then develop a plan of care. As many patients will have significant and sufficient improvement in the first weeks, only some will need additional examination and imaging to confirm or refine the diagnosis, prognosis, surgery or further treatment, or MRI showing a labral or rotator cuff tear. The criteria presented in Table 3 follow the clinical thought process for non-red flag conditions, from the mechanism of illness or injury to unique symptoms and signs of a particular disorder, to test results, if any tests are needed to guide treatment at this stage. It is helpful to know and apply the sensitivity, specificity, and likelihood ratios of examination maneuvers and diagnostic studies to compare the value of various diagnostic approaches.

3.7.1. SPECIAL STUDIES

For most patients with non-traumatic shoulder problems (absent red flags), special studies are not needed, unless a 4- to 6-week period of non-operative care and observation fails to improve symptoms. Most patients improve quickly, provided red-flag conditions are ruled out. There are a few exceptions:

- X-ray is required for most traumatic situations to rule out fracture. There may be exceptions involving minor trauma.
- Stress films of the AC joints (views of both shoulders, with and without the patient holding 15-lb weights) are typically not needed because the disorder is usually clinically obvious. Stress films may help differentiate between Grade 1 and 2, but have little utility as both are treated non-operatively. It may be indicated if the clinical diagnosis is AC joint separation and examination, and standard radiographs are inconclusive.
- If an initial or recurrent shoulder dislocation presents in the dislocated position, shoulder films before and after reduction are indicated. Post reduction films (lateral axillary view) must clearly demonstrate that the humeral head is reduced.

- Persistent shoulder pain, associated with neurovascular compression symptoms (particularly with abduction and external rotation), may indicate the need for an AP cervical spine radiograph to identify a cervical rib and electrodiagnostic testing for nerve injury.
- The threshold for obtaining x-rays whenever there is an unusual clinical presentation should also be particularly low. This includes symptoms suggestive of potential intra-abdominal or cardiac problems presenting as shoulder problems, as well as neoplasias.

Subsequent, additional indications include:

- Traumatic injury with shoulder weakness suggesting rotator cuff tear.
- Traumatic shoulder dislocation in patients over age 40 – high incidence of concomitant rotator cuff tear.
- Physiologic evidence of tissue insult or neurovascular dysfunction (e.g., cervical root problems presenting as shoulder pain, weakness from a massive rotator cuff tear, or presence of edema, cyanosis or Raynaud's phenomenon).
- Failure to respond to treatment as expected.
- Failure to progress in a strengthening program intended to avoid surgery.
- Clarification of the anatomy prior to an invasive procedure (e.g., a full thickness rotator cuff tear not responding to non-operative treatment).

There are considerable methodological weaknesses among the studies of diagnostic tests that include small sample sizes, incomplete assessments of the patients with all tests under consideration, frequent use of retrospective methods, utilization of arthrography for gold standard comparison, and inclusion of patients who had previously been evaluated with the same test or procedure (58). These weaknesses provide substantial concerns about the accuracy of reported test performance characteristics such as sensitivity, positive predictive value, and likelihood ratios. Quality, head-to-head comparisons of diagnostic tests are extremely rare, making quality comparisons between the available diagnostic tests difficult (58). Lastly, relying solely on imaging studies to evaluate the source of shoulder symptoms carries a significant risk of diagnostic confusion, especially false-positive test results, since there is a high probability of identifying a finding that was present before symptoms began (for example, degenerative partial thickness rotator cuff tears), and therefore may have no temporal association with the symptoms.

Routine testing (e.g., laboratory tests, plain-film radiographs of the shoulder) and more specialized imaging studies are not recommended during the first 4 to 6 weeks of activity limitation due to non-traumatic shoulder symptoms, except when a red flag noted on history or examination raises suspicion of a serious shoulder condition, calcific tendinitis, or referred pain. Cases of impingement syndrome are similarly managed.

MRI is especially indicated for imaging soft tissues, particularly including rotator cuff and labral structures. CT is typically more helpful for imaging bony in the shoulder beyond that which is assessable by radiographs, e.g., select patients with osteonecrosis and shoulder dislocation. Earlier imaging with MRI is indicated among those with suspected acute tears of the rotator cuff, especially among younger workers and/or those with functional deficits.

Laboratory studies, such as liver or gallbladder function tests and tests for pelvic disease, may be useful to determine if pain is being referred to the shoulder from a subdiaphragmatic source. Electrocardiography and possibly cardiac enzyme studies may be needed to clarify apparent referred cardiac pain. Chest radiographs may be needed to elucidate shoulder pain that could be the result of pneumothorax, apical lung tumor, or other apical disease such as tuberculosis. An erythrocyte sedimentation rate (ESR), complete blood count (CBC), and tests for autoimmune diseases (such as rheumatoid factor) can be useful to screen for inflammatory or autoimmune sources of joint pain.

3.8. WORK-RELATEDNESS

A determination of work-relatedness is straightforward among those with a significant traumatic workplace event (e.g., substantial slip, trip, fall, or accident). Acute occupational shoulder injuries are related to a specific acute traumatic event – these are non-controversial if the effects are immediate and visible. Physicians should nevertheless clearly document those events and injuries to help support the claim for worker's compensation. The remainder of this section considers those without an acute, significant event. Please also see the Work-relatedness Guideline.

A thorough work history is important to help establish work-relatedness (see General Approach to Initial Assessment and Documentation Guideline for components of work history). Most jurisdictions request an expert opinion as to whether a disease or disorder should be considered work-related for the purpose of workers' compensation. The physician's role is to supply opinion based on medical evidence. The "medical/scientific" answer and the "legal" answer as determined by regulations and case law precedents in a particular jurisdiction (workers' compensation system) often differ. However, in most jurisdictions, the level of evidence is preponderance (more likely than not or over 50%). The best medical decisions are made with support from medical literature and decisions are more supportable with the assignment of a clear diagnosis. Physicians have an ethical responsibility not to simply advocate for their patients (1128). Although most physicians should not be expected to know case law in their state/jurisdiction, they should know that most non-traumatic shoulder disorders involve underlying chronic disease conditions and work-relatedness is often unclear. Lack of clarity and inconsistency in epidemiologic studies decreases the certainty as to whether a workers' compensation claim is supported by medical evidence.

Most epidemiological studies of shoulder disorders are retrospective and either include body regions beyond the shoulder (such as the interscapular region) (1062,1129,1130,1131,1132,1133,1134,1135,1136,1137,1138,1139,1140,1141,1142,1143,1144,1145,1146,1147,1148,1149,1150,1151,1152,1153,1154,1155,1156,1157,1158), combine shoulder pain with neck pain (866,1020,1130,1131,1139,1141,1144,1145,1151,1156,1159,1160,1161,1162,1163,1164,1165,1166,1167,1168,1169,1170,1171,1172,1173,1174,1175,1176,1177,1178,1179,1180,1181,1182,1183,1184,1185,1186,1187,1188,1189,1190,1191,1192,1193,1194,1195,1019,1196,1197,1198), rely solely on subjective data (such as questionnaires for disease and/or exposure data) (253,409,1199,1200,1201,1202,1203), or fail to measure the physical factors associated with the job (1150,1204,1205,1206,1207,1208,1209,1210). This produces considerable uncertainty in these data; statements referable to or actions resulting from these studies should reflect the weakness of the evidence. For most disorders, there is insufficient evidence to conclude causal occupational associations.

No quality ergonomic assessment tools have been developed and validated to establish work-relatedness. For the distal upper extremity, the Strain Index (1211,1212,1213) appears to be the most reliable tool. It has been reported to have some predictive power for shoulder disorders (1213,1214) despite including some components such as hand/wrist posture that are presumably irrelevant. Force is believed to be the major risk for shoulder disorders (1200,1215,61,62,63,1216), which may provide some basis for ergonomic assessments of jobs. The lack of quality ergonomic-epidemiological studies combined with the lack of quality ergonomic job assessment tools is markedly limiting for purposes of both prevention of disorders as well as assessments of work-relatedness of individual cases.

Rotator Cuff-related Disorders

(including tendinoses, partial- and full-thickness tears, impingement syndrome, and subacromial bursitis)

Risk factors for rotator-cuff related disorders are not well-defined. There are no large prospective cohort studies that include physical examinations and detailed job physical exposure measurements to compare, contrast, or quantify purported job physical factor risks. There also are no quality studies of bursitis and few of impingement syndrome. In the absence of other evidence or disorders (e.g., rheumatoid arthritis), it is suggested the following discussion of shoulder tendinopathies applies to those conditions (i.e., impingement syndrome, subacromial bursitis).

Shoulder tendinopathies were increased in a cross-sectional study of shipyard welders (1217) and another study of shipyard plate workers (1218). However, both studies were limited by retrospective methods without adjustments for potential confounders. EMG evidence of supraspinatus fatigue was found with overhead shipyard welding (1219). A small case-control study of shoulder tendinitis cases found elevated risks among those with hand use at or above the shoulder (1220). Another case-control study which measured job physical factors found elevated risks among those with frequent activity and abduction or forward flexion more than 60º (1172). Another found force to be associated with increased risk (1209). A moderately large cross-sectional study reported 5-fold increased risks for a composite of multiple shoulder disorders (e.g., rotator cuff tendinosis, frozen shoulder, acromioclavicular and glenohumeral degenerative joint disease) among those with using high force or high repetition (1221).

A problem with many studies is that factors such as force and repetitiveness are not clearly specified and infrequently measured. Two studies that did specify and measure (252,1131) defined repetitive shoulder use as tasks that entail cycle times of four seconds or less (≤4s), and forceful shoulder use as the application of at least 10 pounds or at least 10% of maximal voluntary contraction force.

Other cross-sectional studies found elevated risks of rotator cuff syndrome among sewing machine operators (1130), grocery checkers (1222), and fish processing workers (23). A population-based registry study of fishery workers found elevated risks for rotator cuff syndrome (1223). A cross-sectional study from a retrospective cohort found elevated risks of shoulder impingement syndrome among meat processing workers (1210). Another large cross-sectional study that included ergonomic assessments found high force and repetition to be associated factors of up to 3- to 4-fold magnitudes (1224). Workers with higher force requirements appear to have increased risk of shoulder tendinosis, rotator cuff tears, and impingement syndrome when identified in large administrative databases (1056,1225,1226).

One prospective cohort study suggested high-hand force was associated with an increased risk of rotator cuff tendinosis (252,1079,1215). However, not all data support that supposition (253,1034). High force and high repetition, and repetition alone (94,1227) are reported risk factors (1041,1216,1224,1228,1229). Other data suggest working with the hands above the shoulder is a risk factor (416). Other data suggested either long duration of shoulder flexion (252) or arm abduction are risk factors (1229). However, these results are not consistent among studies. Other studies have not found elevated risks of shoulder tendinitis, including one of assembly line packers (1230) and others of manufacturing workers (1231), sewing machine workers (1231), heavy work (1232), bricklayers (419), rockblasters (419), and data entry workers (1233).[a] A prospective cohort study to evaluate risks of shoulder postures found large within-group variance in exposures and an inability to detect postural risks for shoulder disorders (1224). Another prospective cohort study evaluating working postures found postural variations were associated with musculoskeletal symptoms throughout the body (1160). A prospective cohort of baggage handlers found longer cumulative years of employment was associated with subacromial shoulder disorders (1234). One small cohort found increased risk of shoulder pain among those with increased measured arm elevation (1235). Unaccustomed use is believed to be a risk factor, particularly involving forceful use that the individual does not normally perform.

Psychosocial factors have been associated with the presentation of rotator cuff tendinitis, including self-perception of poor health (1020,1236,1237). However, most studies of psychosocial factors

evaluated combined neck-shoulder disorders or shoulder girdle pain. These studies found risks that included stress (1020,1132,1238), somatization (1239,1240), job demand (1040,1131,1176,1200,1229,1241,1242), high distress (1131,1243,1244,1245), high psychological demand (1200,1216,1229,1246,1247,1248), low job control (252,418,1040,1131), job strain (1148,1249,1193), low social support (1020,1131,1248,1250), job dissatisfaction (1239,1250,1251), depressive symptoms, effort-reward imbalance (1252,1253), low job security (252,1040), smoking (421,1020,1254), living alone with children (1020), low socioeconomic status (1236), and work organizational issues (1255,1256). Risks of disability were higher among foreign-born workers and women in a Swedish population-based prospective cohort study (1257). Reduction in risk of shoulder and neck pain has been reported with regular leisure time physical activity (1242). However, another study suggested inconclusive evidence of the relationship between physical capacity and risk of shoulder pain (1258). A Finnish study reported increased risk of early retirement particularly among those with both heavy physical work combined with low cardiorespiratory fitness (1259).

Non-occupational risks for rotator cuff-related disorders: Rotator cuff disorders are not characterized by frank inflammation; however, inflammatory mediators may be present in rotator cuff tear, tendinitis, and impingement patients. These include increased: interleukin-1 (109,117,112), interleukin-6 (112,1260), interleukin-8 (1261), tumor necrosis factor-alpha (109,112), basic fibroblast growth factor (109,116), transforming growth factor (109,116), metalloproteinases (112), CD2-positive T-lymphocytes (113), tenascin-C (114), substance P (110), and vascular endothelial growth factor (115). It is unknown whether these factors precede or are a consequence of the disease processes. Associations have been found between severity of musculoskeletal disorders (MSDs) and inflammatory mediators (1262).

Some factors increase risk for shoulder pain and rotator cuff-related disease including obesity (251,252,253,866,417,1247,1263,1264), smoking (251,418,419,421,1020,1265,1266,1267,1268), hypercholesterolemia (1269), hyperlipidemia (1270,1271,1272,1273), diabetes mellitus (416,1229,1247,1264,1270,1274,1275,1276), and atherosclerotic disease risks (250,417). These factors may be reduced with active exercise and lipid-lowering therapy (253,1273). Genetic factors are also reported risks (1277,1278,1279). Evidence increasi0ngly supports cardiovascular disease as a mechanism for the development of rotator cuff tendinitis and tears (423,1280).

The prevalence of full-thickness rotator cuff tears in asymptomatic individuals over age 50 is reported to be 6 to 51% (1026,1033,1034). In cadavers, 23.1% had partial or full-thickness tears (1031). A systematic review (1031) exploring the frequencies of rotator cuff tears in asymptomatic and symptomatic persons resulted in aggregate findings, which are summarized in the table below. When comparing the frequency of symptomatic to asymptomatic rotator cuff tears revealed on diagnostic imaging, as many as half of tears, particularly if partial-thickness, may not be the pain generator.

The prevalence of any asymptomatic tear was approximately 40%, with symptomatic tears occurring from about the same to nearly double the frequency, depending on the method of detection used. Age is a major risk factor for tendinitis and full and partial-thickness rotator cuff tears (1109,999,1002,1005,252,416,1024,1025,1281,1031,1033,1034,1036,1037,1038,1039,1040,1041,1042,1043,1044,1045,1282,677). One study suggests age, BMI, repetitive work, and diabetes are all associated with higher risk for bilateral rotator cuff tears compared to monolateral tears (677). Risk is greater on the dominant side (252,1034,1035,1283), although that is not a universal finding (1025). Smoking is a risk factor for accelerated speed of a degenerative tear (1284).

Tears of the supraspinatus tendon have been associated with tears of the remaining rotator cuff tendons, including the subscapularis (1038), as well as bicipital tendon tears (181,1285). The prevalence of Type II and III acromions rises with age and is associated with rotator cuff pathology and tears in asymptomatic (1026,1027) and symptomatic patients (1286). However acromion type may not impact rotator cuff repair (1287). Over age 70, the prevalence of Type II and III acromions is 80 to 93% (1025,1026). Evidence also suggests a relatively weak association between cuff tears and acromial

types. One study suggests there is a higher risk of rotator cuff tear for those with Type III acromions compared to Type I or II (1288). The reliability of classifying acromial type is poor, although large spurs have been associated with a higher risk of tear (1289).

Degenerative processes tend to occur in both shoulders (1043). Risk factors reported for degenerative processes include heredity (1278), ankylosing spondylitis (1290), rheumatoid arthritis, crystal diseases (e.g., gout, pseudogout, hydroxyapatite), trauma (1034), and sports activities (419).

There is evidence to suggest that preoperative expectations for rotator cuff issues are associated with surgical recovery outcomes (1291). Fear avoidant beliefs have been prospectively shown to be related to risk of sick leave for workers with musculoskeletal pain (1292). Sleep disturbance among workers with neck-shoulder pain predicted sickness absence at 5 years (1293) and was a risk for neck-shoulder-arm pain in a large cohort (1294).

Acromioclavicular (AC) Sprain, Separation, and Dislocation

AC joint sprains and separations are mostly reported in sports from blows to the shoulder or falls (1295,1296,1297,1298,1299,1300,1301,1302,1303,1304,1305,1306); predominately among young males in the second and third decades of life (1042). Some AC injuries may occur as a result of occupational injuries including falls. Shoulder separation should be visible, or at least documentable, by radiographic study.

Acromioclavicular (AC) and Glenohumeral Arthrosis

The shoulder may be affected by osteoarthrosis (716). In symmetrical cases, an occupational basis is difficult to identify. There are no consistent findings of one job type or class to be associated with shoulder arthroses involving either joint. There is also a strong propensity towards osteoarthrosis to develop in other joints in the body once an individual has already developed symmetrical arthrosis in another body region, likely signifying genetic or other systemic predispositions (systemic osteoarthrosis) (1307,1308,1309,1310,1311,1312,1313,1314,1315). Age is a clear osteoarthrosis risk (126,1316,1317). All joints are susceptible to involvement with systemic rheumatological conditions, also including rheumatoid arthritis (1318). Joints are also affected by crystal arthropathies including gout and pseudogout. Obesity may act through a systemic mechanism (1319,1320,1321). Anatomic evidence of AC joint arthrosis is common, with an estimated prevalence of 29% of cadavers that included apparent age-related effects (126), as well as more AC arthrosis on the right side (1317). Elevated risks of acromioclavicular arthrosis have been reported in fish-processing workers (23), bricklayers (1322), and those active in sports (419). Few epidemiological studies have reported quantified exposure-disease outcomes for glenohumeral arthroses and so work-relatedness is unclear; however, some cases may occur after work-related fractures and thus may more clearly be considered occupational. A history of shoulder dislocation and operative treatment are associated with increased risk for glenohumeral arthritis (1323).

Adhesive Capsulitis

Most cases of adhesive capsulitis are idiopathic. Although some persons may claim to develop pain or limited mobility after a minor injury and subsequently be assigned a diagnosis of adhesive capsulitis, there are currently no quality studies demonstrating this cause and effect. Adhesive capsulitis may occur due to systemic risk factors. Calcific tendinitis, rotator cuff tendinitis, bicipital tendinitis, impingement syndrome, fractures, dislocation, and osteoarthritis have been shown to be associated factors in a large population-based case-control study of 24,414 patients (1324). Some patients develop adhesive capsulitis based on systemic risks such as age, female sex (1324,1325), obesity (1326), lower BMI (1327), gout (1328), diabetes mellitus (1326,1327,1329,1330), high sensitivity C-

reactive protein (1329), and hypothyroidism (1331,1332). Shoulder contracture after surgery may present similarly to adhesive capsulitis.

Fractures

All shoulder fractures, except for pathologic fractures, are the result of trauma. Fractures are commonly due to sports, motor vehicle crashes, or occupational accidents (1333). Fractures in younger adults are more likely to involve higher energy trauma than those in the elderly, potentially due to osteoporotic changes with aging. Falls are the most common cause of shoulder fractures among the elderly (1334).

Glenohumeral Dislocation, Instability

A first-time occurrence of dislocation in the context of a discrete violently traumatic occupational event is work-related. Once a normal shoulder dislocates (i.e., there is an absence of a congenital anomaly), the joint capsule and ligaments are permanently stretched and the shoulder is prone to re-dislocate. Thus, in individuals with a prior history of dislocation, there is an increased risk of re-dislocation and/or instability. Redislocation in the absence of a significant work accident or event is non-occupational. There are fewer clear cases in which there is prior instability but an occupational event that sometimes results in the cases being considered work-related, depending on the magnitude of the event. Multiple studies show that recurrence of shoulder dislocation is common in multiple populations and clinical studies (1335,1336,1337,1338,1339,1340,1341,1342,1343), with some studies of shoulder dislocation showing the majority of persons who experienced shoulder dislocation had recurrence (1338,1340,1344,1345,1346), with re-dislocation rates up to 29% (1347), 62% (1344), and 68% (1345), depending on the population. Overall, the earlier (younger) the initial dislocation, the likelier re-dislocation (1335,1346,1347,1348,1349,1350). Depending upon the patient's age, glenohumeral dislocation can cause substantial rotator cuff injury. Proprioceptive (position-sense) deficits might contribute to shoulder instability and injury (1344,1345,1351). It is unknown whether proprioceptive deficits precede and dispose to injury or result from injury.

Labral Tears

There are no quality epidemiological studies on the causes of labral tears or the reasons labral tears become symptomatic. Labral tears frequently accompany glenohumeral dislocation (dislocated shoulder) (1352,1353). Shoulder and hip labral tears have been found to coexist with each other in patients (1354). A non-contrasted MRI study of 53 adults ages 45-60 with no shoulder pain history were interpreted as showing 55-72% of patients were consistent with labral tear(s) (1355). Another small prevalence study reported 20% of asymptomatic shoulders have MRI evidence of labral tears and 20% of those with prior shoulder pain have evidence of rotator cuff tears (1356). The prevalence of labral tears on MRI at the National Football League's Combine was 14.9% (1357). Aging is a strong risk factor (1355,1358,1359).

Trigger Points/Myofascial Pain/Muscle Tension Syndromes

No quality epidemiological studies demonstrate a work relationship for myofascial pain and trigger points. There is some evidence suggesting that certain cases of muscle tension syndrome may be occupational and that this disorder may be related to myofascial pain (1020,1144,1147,1151,1360,1361,1362). However, the quality of studies reported has been suboptimal. True risk factors are not well-defined (1363). Myofascial pain is often assigned as work-related when the pain arises in a body part subject to a clear occupational injury or when there is an

inciting event without prior history, the pain and signs are limited to one body region, and are not bilateral or disseminated. Myofascial pain syndrome has been reported to be related to years of sewing with higher prevalence in those inexperienced and those with long years on the job (i.e., a U-shaped relationship) (1020). Stress and anxiety have also been associated with myofascial pain syndrome (1020,1364), with a few studies specifically assessing computer workers in stressful situations (1365,1366). Myofascial trigger points are associated with migraine and tension-type headaches (1364,1367), endometriosis (1368), chronic pelvic pain (1369), temporomandibular joint pain (1370), and head/neck surgery (1371). Fibromyalgia is considered a non-occupational condition and is reviewed in the Chronic Pain Guideline.

Thoracic Outlet Syndrome

There are no quality studies that address thoracic outlet syndrome (TOS). TOS is commonly attributed to multiple underlying causes, including neurological compression, vascular compression, scalene muscle tightness, and compression by the first thoracic rib or a cervical rib (1372,1373). Thus, work-relatedness is unknown and cases without an identifiable cause of compression are controversial (1373,1374,1375,1376). Some cases occur due to neurovascular compression, including cervical ribs, and thus are congenital. Others occur due to sequelae of trauma (e.g., scar tissue) or secondary to another shoulder disorder. Many occur without a clear provoking cause, although some patients report worse symptoms at work (1375,1377). However, reported worsening with activities or at work does not show a cause-and-effect relationship.

Nonspecific Shoulder Pain

There are no quality studies documenting that non-specific shoulder pain is or is not an occupational condition. Non-specific pain has been typically studied in ergonomic-epidemiological investigations lacking a medical diagnostic component utilizing questionnaires to ascertain a case definition of shoulder or neck/shoulder pain. Using these methods, shoulder pain has been associated with keyboarding, lower educational achievement, poorer self-reported physical fitness, manual handling, working with hands above shoulder level, lifting above shoulder level, heavy lifting, and working with vibrating tools (1378,1180,1203,1236,1362,1379,1380,1381). In non-specific shoulder pain, psychosocial issues including depression and stress are more prevalent (416,1203,1380). There is evidence that non-specific shoulder pain is also commonly related to sports, particularly swimming (1382,1383,1384,1385,1386,1387,1388). Commonly, non-specific shoulder pain is medically diagnosable as having a specific diagnosis either with a thorough examination and/or with time.

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[a] Many of the epidemiological studies are sufficiently old that the work tasks likely are no longer performed or are substantially different today. Regardless, these studies are included to provide the references of the exposures, not the job tasks, per se.

3.9. TREATMENT RECOMMENDATIONS

3.9.1. GENERAL APPROACH TO TREATMENT

Assuring that there are no red flags is the first concern. Next, the patient's functional level should be assessed, as a function-based treatment strategy is helpful. Activity levels and simple exercises are often the next consideration as a central aim of a function-based treatment strategy. Ice/heat may be prescribed. Nonprescription analgesics may provide sufficient pain relief for most patients with shoulder pain. If treatment response is inadequate (i.e., if symptoms and activity limitations continue)

or the physician judges the condition limitations to be more significant, prescribed pharmaceuticals or physical methods may be added. Co-morbid conditions, invasiveness, adverse effects, cost, and physician and patient preferences guide the choice of treatment. Initial care and comfort items may include non-steroidal anti-inflammatory drugs (NSAIDs), acetaminophen, heat, exercises, and/or advice on activities. Education about shoulder pain begins at the first visit.

Initial treatment should be guided by implementing conservative care supported by the strongest evidence for treating the presumed diagnosis. For many disorders, there is no high-quality evidence to guide treatment. If there is also no moderate-quality evidence to guide treatment, the provider should consider including non-invasive, convenient, and inexpensive treatments that are widely accepted, but have not been subjected to RCTs or crossover trials (e.g., pendulum exercises for acute shoulder pain patients to facilitate recovery and prevent adhesive capsulitis). Careful consideration of the indications and limitations described in the rationale for each recommendation is critical to understanding the best application for each intervention. If treatment response is inadequate (that is, if symptoms and activity limitations continue), other recommended treatments may be considered. Physicians should consider the possibilities of diagnosed and previously undiagnosed medical diseases such as diabetes mellitus and various arthritides.

The principal recommendations for assessing and treating patients with shoulder disorders are as follows:

- The initial assessment focuses on detecting indicators of potentially serious disease, “red flags,” and making an accurate diagnosis.
- In the absence of red flags, work-related shoulder disorders may generally be safely and effectively managed by non-operative means. The focus is on the initial use of the most efficacious treatment strategy or strategies, monitoring for progression and complications, modifying treatment to facilitate the healing process, and facilitating return to work in a modified- or full-duty capacity. Including patient’s treatment preferences may be helpful (59).
- Nonprescription analgesics (NSAIDS and acetaminophen) may provide sufficient pain relief for most patients. If treatment response is inadequate (i.e., if symptoms and activity limitations continue), incrementally expand treatment to include prescription medications, treatment modalities such as physical or occupational therapy, steroid injections, and/or surgery. Pain relief may be accomplished by activity modification, commonly limiting shoulder activities to below shoulder level and limiting the weights lifted for those significant exposure activities.[a]
- Identifying the worker’s job tasks and functional goals, including returning to work, can aid the formulation of an appropriate treatment plan and work restrictions.
- Patients recovering from work-related shoulder injuries are encouraged to return to modified work and normal activity levels as soon as their condition permits.
- Nonphysical factors such as psychosocial, workplace, or socioeconomic problems should be assessed early in and over the course of care and addressed in an effort to prevent or resolve delayed recovery (60).

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[a]The most compromised biomechanical position for the shoulder in biomechanical experimental studies is 90 to 120° of abduction and forward flexion. Maintaining higher overhead height is less compromising to the shoulder than lowering to 90° if the object cannot be lowered substantially (61,62,63).

3.9.2. EDUCATION

Education has been used to treat shoulder disorders (64,65,66,67,68,69,70,71,72,73,74,75,76,77,78)

EDUCATION FOR SHOULDER DISORDERS

Recommended

Education is recommended for patients with shoulder disorders.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

All workers with shoulder disorders.

Benefits

Improved understanding of the disorder, which may improve compliance with the therapeutic plan.

Harms

Negligible

Frequency/Dose/Duration

One or 2 appointments for educational purposes, often performed in conjunction with treatment and/or therapy; may include information about self-care and rehabilitation; may teach adaptive techniques and use of adaptive equipment (as indicated) to facilitate continued participation in daily activities despite limitations. Additional appointments may be needed if education is combined with physical therapy or occupational therapy treatments. Follow-up educational visit(s) for more severe disorders as part of a progression towards normal functional use is sometimes helpful.

Indications for Discontinuation

Completion of 1-2 visits. Added appointments are occasionally needed for more severely affected individuals.

Rationale

One moderate-quality trial appears to have largely focused on educational interventions, although it also appears to have included exercises and have suffered a randomization failure that may have biased towards the null (De Bruijn et al., 2007). There are no other quality studies specifically evaluating efficacy of patient education for utility or necessity in the treatment of shoulder disorders. Yet for many disorders, education (e.g., importance of performing pendulum exercises, advancement of activity levels) appears essential. Some providers accomplish this in the course of extended patient visits, while others routinely refer patients to a physical or occupational therapist for education. Regardless of the approach, a few appointments for educational purposes are recommended as a low-cost treatment adjunct for many patients. The number of appointments is dependent on the diagnosis, severity of the condition, and co-existing conditions. Although education is usually incorporated as

part of the overall treatment plan, an additional 1 or 2 appointments for purely educational purposes may be helpful midway through a treatment course for the more severely affected patient.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar, without date limits using the following terms: Education; shoulder, shoulder pain, shoulder disorders; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 132 articles in PubMed, 19,071 in Scopus, 129 in CINAHL, 1305 in Cochrane Library, 67,500 in Google Scholar, and 2 from other sources†. We considered for inclusion 9 from PubMed, 2 from Scopus, 4 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 17 articles considered for inclusion, 4 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens, then the remaining articles are not reviewed due to a lack of relevancy.

3.9.3. ERGONOMIC INTERVENTIONS

Ergonomic interventions have been used to treat general shoulder disorders (1203,1389,1390,1391,1392,1393,1394,1395,1396,1397,1398,1399,1400,1401,1402,1403,1404,1405,1406,1407,1408,1409,1410,1411,1412,1413). In order to facilitate recovery and prevent recurrence of shoulder disorders, the physician may recommend work and activity modifications and/or ergonomic redesign of the workplace (1414). The employer's role is crucial in facilitating the employee's return to full duty activity. The employer is responsible for accommodating activity limitations and preventing new or further injury through reassignment of tasks in the short-term and ultimately instituting ergonomic changes to how tasks are performed in the long-term. It may be desirable to conduct an ergonomic analysis of the activities that may be contributing to the symptoms. Keyboarding and computer (mousing) breaks have been used to treat shoulder disorders (1415,1416). Forearm supports have been used to prevent neck and shoulder symptoms (1417). Ergonomic training in moderate- or high-risk manufacturing settings has been used for shoulder disorders (1402,1418,1419). Ergonomic training in office settings have been used for musculoskeletal disorders (1420,1421,1391,1392,1393,1397,1399,1400,1422,1423,1424,1425,1426,1427,1428,1429). There are no quality validated ergonomic instruments available for evaluating shoulder exposures (61,62,63,1430,1431,1432). Evaluations of force (weights of parts and tools lifted, moment arms, torque), duration of exertion, and shoulder posture (forward flexion, abduction, horizontal reach) should be assessed (63,1433). Psychological factors such as organizational relationships and job satisfaction should also be assessed. Modifications of activity, workstation redesign, or organizational and management changes may be considered. Consultation with a certified ergonomist, occupational or physical therapist, human factors engineer, or occupational medicine physician is suggested.

ERGONOMIC INTERVENTIONS FOR SHOULDER DISORDERS, PARTICULARLY ROTATOR CUFF TENDINOPATHIES

Recommended

Ergonomic interventions are recommended in settings with combinations of risk factors (e.g., high force combined with forward flexion and/or abduction and high repetition) to reduce risk factors for rotator cuff tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Jobs with combinations of high force, high repetition, and forward flexion/abduction of 90+ degrees.

Benefits

Theoretical potential to reduce risk of (re)injury

Harms

Cost, job elimination, implementation of job changes that may not result in changes in injury rates

Rationale

There are limited quality studies of ergonomic interventions for purposes of assessing subsequent risks of specific shoulder injuries. Quality studies of ergonomics interventions have been reported only for office settings (Rempel et al., 2006, Verhagen et al., 2006, Rempel et al., 1999, Gerr et al., 2005, Tittiranonda et al., 1999). Nevertheless, in jobs with high ergonomic factors, particularly combined high force, shoulder postures between 90 and 120 degrees of forward flexion or abduction and high-repetition, interventions are recommended to reduce exposures (Garg et al., 2002, Garg et al., 2005, Garg et al., 2006, Herbert et al., 2000).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ergonomic Interventions; shoulder, shoulder pain, shoulder disorders; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 56 articles in PubMed, 45 in Scopus, 11011 in CINAHL, 2 in Cochrane Library, 1,040 in Google Scholar, and 0 from other sources†. We considered for inclusion 13 from PubMed, 7 from Scopus, 3 from CINAHL, 0 from Cochrane Library, 4 from Google Scholar, and 0 from other sources. Of the 27 articles considered for inclusion, 6 randomized trials and 9 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANDATORY TYPING POSTURE FOR PREVENTION OF SHOULDER DISORDERS

Not Recommended

Mandating a traditional sitting posture at a keyboard or desk with elbows, hips, and knees at 90° of flexion is not recommended for prevention or treatment of shoulder/neck disorders. Mandating any specific typing posture is not recommended. Instead, allowing flexibility to choose comfortable typing posture(s) is recommended and may improve workplace satisfaction.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Low

Rationale

Quality studies of ergonomics interventions have been reported only for office settings (Rempel et al., 2006, Verhagen et al., 2006)(Rempel et al., 1999, Gerr et al., 2005, Tittiranonda et al., 1999). Quality evidence has reported no beneficial effects of the 90-degree typing posture (seated erect; feet on floor; knees, hips, and elbow joints all at 90-degree angles), instead it has the same injury rates as a laid-back posture when examining distal upper extremity disorders of neck/shoulder symptoms (Gerr et al., 2005). Thus, a 90/90 typing posture is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Typing Posture for Prevention and Treatment; shoulder, shoulder pain, shoulder disorders; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 4 articles in PubMed, 0 in Scopus, 10,971 in CINAHL, 0 in Cochrane Library, 15,700 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 2 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANDATORY TYPING POSTURE FOR TREATMENT OF SHOULDER DISORDERS

Not Recommended

Mandating a traditional sitting posture at a keyboard or desk with elbows, hips, and knees at 90° of flexion is not recommended for prevention or treatment of shoulder/neck disorders. Mandating any specific typing posture is not recommended. Instead, allowing flexibility to choose comfortable typing posture(s) is recommended and may improve workplace satisfaction.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Quality studies of ergonomics interventions have been reported only for office settings (Rempel et al., 2006, Verhagen et al., 2006)(Rempel et al., 1999, Gerr et al., 2005, Tittiranonda et al., 1999). Quality evidence has reported no beneficial effects of the 90-degree typing posture (seated erect; feet on floor; knees, hips, and elbow joints all at 90-degree angles), instead it has the same injury rates as a laid-back posture when examining distal upper extremity disorders of neck/shoulder symptoms (Gerr et al., 2005). Thus, a 90/90 typing posture is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Typing Posture for Prevention and Treatment; shoulder, shoulder pain, shoulder disorders; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 4 articles in PubMed, 0 in Scopus, 10,971 in CINAHL, 0 in Cochrane Library, 15,700 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 2 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

KEYBOARDING BREAKS FOR PRIMARY PREVENTION OR TREATMENT OF SHOULDER DISORDERS

Recommended

Keyboarding and computer (mousing) breaks are recommended for primary prevention and for patients with symptoms of shoulder disorders.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

All workers performing largely keyboarding work.

Benefits

Reduced fatigue. Theoretical possible reduction in injury.

Harms

Cost, wasted resources if ineffective.

Rationale

Quality studies of ergonomics interventions have been reported only for office settings (Verhagen et al., 2006, Rempel et al., 1999, Gerr et al., 2005, Tittiranonda et al., 1999).

Breaks from computer typing have been addressed in a low-quality study that reported reductions in symptoms, but no additional benefit from utilizing exercise during breaks (van den Heuvel et al., 2003). Various types of breaks have been utilized including stretching breaks and exercise programs (Lee et al., 1992, Galinsky et al., 2000, Carter et al., 1994, Silverstein et al., 1988, Feuerstein et al., 2004, Fenety et al., 2002, Balci et al., 2004, Henning et al., 1997). Quality evidence supporting the efficacy of breaks is weak, especially for symptomatic patients (van den Heuvel et al., 2003, Galinsky et al., 2000). One low-quality randomized study among an apparently asymptomatic population of temporary data-entry workers suggested fewer symptoms among those taking breaks; however, compliance was low (ranging from 25 to 39%). Breaks are not invasive, have no substantial adverse effects, are low cost, and do not appear to impair productivity (van den Heuvel et al., 2003, Balci et al., 2004, McLean et al., 2001, Henning et al., 1997, Balci et al., 2003, Floru et al., 1987, Sauter et al., 1992, Kopardekar et al., 1994). Widespread use of these programs has not been reported in quality studies; however, with no apparent significant cost impacts and studies suggesting potential benefits, breaks are recommended for both primary prevention and treatment of symptomatic patients.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Keyboarding Break for Prevention and Treatment, keyboarding break; shoulder, shoulder pain, shoulder disorders; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 0 in Scopus, 10,971 in CINAHL, 0 in Cochrane Library, 5,580 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 2 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

FOREARM SUPPORT FOR TYPING TO PREVENT NECK/SHOULDER SYMPTOMS

Recommended

Forearm support for frequent computer keyboard users is recommended for potential prevention of neck and/or shoulder symptoms.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Consider for all workers performing largely keyboarding work.

Benefits

Reduced fatigue. Theoretical possible reduction in injury.

Harms

Cost, wasted resources if ineffective.

Rationale

Quality studies of ergonomics interventions have been reported only for office settings (Rempel et al., 2006, Verhagen et al., 2006, Rempel et al., 1999, Gerr et al., 2005, Tittiranonda et al., 1999). Nevertheless, in jobs with high ergonomic factors, particularly combined high force, shoulder postures between 90 and 120 degrees of forward flexion or abduction and high-repetition, interventions are recommended to reduce exposures (Herbert et al., 2000, Garg et al., 2002, Garg et al., 2005, Garg et al., 2006). Some evidence suggests reductions in neck/shoulder symptoms might be realized through utilization of a forearm support (Rempel et al., 2006); thus, forearm support is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Forearm Support for Typing and Prevention, forearm support; shoulder, shoulder pain, shoulder disorders; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 14 articles in PubMed, 31 in Scopus, 10,980 in CINAHL, 1 in Cochrane Library, 582 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ERGONOMICS TRAINING IN MODERATE- OR HIGH-RISK MANUFACTURING SETTINGS

Recommended

Ergonomics training is recommended in moderate- or high-risk manufacturing settings.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

All workers performing manual work, particularly with injury risks that include combined high force, repetition, and posture of 90+ degrees of abduction and/or forward flexion.

Benefits

Theoretical possible reduction in injury.

Harms

Cost, wasted resources if ineffective.

Indications for Discontinuation

Able to demonstrate knowledge

Rationale

Quality studies of ergonomics interventions have been reported only for office settings (Verhagen et al., 2006, Rempel et al., 1999, Gerr et al., 2005, Tittiranonda et al., 1999). Nevertheless, in jobs with high job physical demands for the shoulder, particularly combined high force, shoulder postures between 90 and 120 degrees of forward flexion or abduction and high-repetition, interventions are recommended to reduce exposures (Herbert et al., 2000, Garg et al., 2002, Garg et al., 2005, Garg et al., 2006).

There is no quality evidence regarding the use of ergonomics training, it is thought to be beneficial in high-risk settings. One study suggested that training is inferior to a combination of other interventions in an office setting (Rempel et al., 2006) and another found benefits for the neck, but not distal upper extremity (Ketola et al., 2002). An RCT comparing wrist splinting with ergonomic education found splinting superior (Werner et al., 2005). If there is a benefit of ergonomic training, it may be modest. Training should consist of quality information.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ergonomic Training in Manufacturing Settings, ergonomic training, manufacturing, ergonomics; shoulder, shoulder pain, shoulder disorders, manufacturing facilities; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 40 articles in PubMed, 0 in Scopus, 10,980 in CINAHL, 1 in Cochrane Library, 144 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 3 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 3 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search,

and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ERGONOMICS TRAINING FOR PREVENTION OF MUSCULOSKELETAL DISORDERS IN OFFICE SETTINGS

No Recommendation

There is no recommendation for or against the use of ergonomics training for the prevention of MSDs in office settings.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

While quality evidence is lacking regarding the use of ergonomics training, it is thought to be beneficial in high-risk settings. One study suggested that training is inferior to a combination of other interventions in an office setting (Rempel et al., 2006) and another found benefits for the neck, but not distal upper extremity (Ketola et al., 2002). An RCT comparing wrist splinting with ergonomic education found splinting superior (Werner et al., 2005). If there is a benefit of ergonomic training, it may be modest. Training should consist of quality, evidence-based information (e.g., force is the most important risk factor, not rotely prescribing a 90/90 typing posture).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: ergonomic training, ergonomics, office, ergonomic intervention; shoulder, shoulder pain, shoulder disorders; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 54 articles in PubMed, 238 in Scopus, 11,500 in CINAHL, 1 in Cochrane Library, 5,930 in Google Scholar, and 7 from other sources†. We considered for inclusion 11 from PubMed, 6 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 7 from other sources. Of the 26 articles considered for inclusion, 17 randomized trials and 4 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

3.9.4. RETURN-TO-WORK PROGRAMS

Return-to-work programs have not been well studied among patients with shoulder disorders. Generally, these programs include gradual increase in shoulder use, especially focusing on strength, repetition, and endurance. Several studies suggest that a job's physical demands, lack of job accommodation, and psychosocial conditions are the most important factors in predicting work

disability (79,80,81). Return-to-work interventions have been used for those diagnosed with a shoulder disorder (82,83,84,85,86,87,88,89,90).

RETURN-TO-WORK PROGRAMS FOR TREATMENT OF SUBACUTE OR CHRONIC SHOULDER DISORDERS

Recommended

Return-to-work programs are recommended for treatment of subacute or chronic shoulder disorders, particularly in patients with significant lost time.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients with subacute or chronic shoulder disorders who have completed acute treatment. Generally, should have attempted at least 1 trial of return to work that was unsuccessful. May also have trialed a second, more graded return to work, both of which were unsuccessful. (Acute pain patients generally resolve and do not require a formal return to work program.)

Benefits

Earlier return to work (RTW).

Harms

Negligible

Indications for Discontinuation

Achievement of RTW status

Rationale

There are no quality studies that review the types of return-to work programs typically found in the United States. There is one quality study from Spain (Abasolo et al., 2007); however, the patients had spine disorders and the program otherwise may have limited applicability due to longstanding, early active management of these issues in the United States. Thus, this study has limited if any applicability to the United States. These programs are thought to reduce morbidity and improve function. They are not invasive, have minimal potential for adverse effects, and are not costly. Return-to-work programs are recommended for management of select patients with shoulder disorders with lost time and may be helpful for proactive emphases on functional recovery.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Return to Work, RTW, Job Re-Entry; shoulder, shoulder pain, shoulder disorders; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 55 articles in PubMed, 1,607 in Scopus, 35 in CINAHL, 3 in Cochrane Library, 51,700 in Google Scholar, and 0 from other sources†. We considered for inclusion 6 from PubMed, 3

from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 9 articles considered for inclusion, 2 randomized trials and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

3.10. WORK ACTIVITY MODIFICATIONS

Work activity modifications are often necessary during the treatment course for patients with acute, subacute, and chronic shoulder pain, regardless of cause. Advice on work and non-work-related limitations should be specific, rather than "light duty." A paradigm of risk, capability, and tolerance has been published by American Medical Association, and while risk and capability may be relatively well understood, tolerance is difficult and often integrally connected with behavioral attributes (91). When the worker's tolerance is too low, and especially when tolerance does not improve with time and progress, work limitations are needed to be advanced beyond the usual "as tolerated" prescription.

Advice on how to avoid exacerbating activities that at least temporarily increase pain includes a review of work duties. Continuing some activities helps prevent weakness, atrophy and mobility loss. Sometimes, workers have sufficient self-directed flexibility in their work duties such that formal limitations may not be needed, as they can adapt and incorporate the medical advice on limitations into their daily work tasks. Most of the time, modifications in limitations must be written out for the employer. Slings should be avoided for anything other than for clear indications (e.g., AC separation, AC high-grade sprain). Gentle ROM exercises (e.g., pendulum) should be performed at least twice daily, even when a sling is provided. Patients should avoid work activities that precipitate or significantly increase symptoms during the acute phase of treatment, but should continue general activities of daily living as tolerated (see caveat regarding tolerance above, whereby insufficient tolerances should result in replacement of the words "as tolerated" with specific activities to perform, modify, or not perform). Every attempt should be made to maintain patients at the maximal levels of activity, including work, hobbies, and sports activities as it is in the patient's best interest (92). Poorer prognosis with longer persistence of pain has been associated with slower onset of pain, higher pain severity at presentation, and longer duration of symptoms (93,94).

The first step in determining whether work-activity modifications are required usually involves a discussion with the patient regarding the nature of job tasks and the overall job physical demands (95). In such cases where the worker can make modifications, e.g., reduce shoulder torque by lifting of a box after pulling the box to the shelf edge or receive assistance to lift a box or reduce reaching, there may be no requirement to write any restrictions even if strength, ROM, or pain are limiting. In some situations, it may be advisable to confirm this report with the patient's supervisor to signal that the person is under treatment.

In most cases, specified limitations may be a better treatment strategy. Assessment of work activities and potential for modifications may also be facilitated by a worksite visit and analysis by a health care provider with appropriate training (e.g., physician, occupational therapist, physical therapist, or ergonomist). Despite their limitations, ergonomic guidelines should be considered when assigning activity limitations.

Work limitations should be tailored by considering the following factors: 1) job physical requirements; 2) the safety of the tasks in consideration of the diagnosed condition, age, and relevant biomechanical limitations; 3) severity of the problem; 4) work organizational issues (overtime, work allocation, wage incentives); and 5) the patient's understanding of the condition. Sometimes it is necessary to write limitations or to prescribe activity levels that are above what the patient is comfortable doing, particularly when the patient wants to avoid all activity. In such cases, the physician should be careful not to overly restrict the patient; education about the problem of pain itself causing disability and the need to remain active should be provided.

It is best to communicate early in the treatment that limitations will be progressively reduced as the patient progresses. Experienced physicians communicate the intended changes in restrictions for the coming week (similar to forecasting increases in exercise program components) at the current visit to reduce the element of surprise and help actively facilitate the patient's most important elements of an active, functional restoration program. Tailoring restrictions is required in nearly all patients with chronic shoulder pain as there is great variability in symptoms and dysfunction. The employer should also be consulted when developing strategies to expedite and support integrating the patient back into the workplace (see Low Back Disorders). The physician can make it clear to patients and employers that:

- Patients sometimes have increased pain performing almost any function (even light duty) early in rehabilitation;
- Increases in symptoms should be heard with -empathy, and factors which are associated with significant increases in pain should be addressed;
- Increases in pain do not equate to injury;
- Any restrictions are intended to allow for time to build activity tolerance through exercise and work reconditioning; and
- Where appropriate, it may help to mention to the patient that this rehabilitative plan will also help the patient regain normal non-occupational activities.

The following are common limitations that may be needed for acute shoulder pain patients:

- No lifting more than 10 pounds (this may require adjusting up or down based primarily on the patient's pre-morbid capabilities and the severity of the condition).
- Avoid more than 60º abduction or forward flexion. Although not necessarily anatomically correct, this is sometimes described as avoiding lifting with the hands above shoulder height to facilitate implementation.
- Some additionally required limitations such as avoiding static use or highly repetitive use.

The physician may also need to educate the employer that:

- Even moderately heavy (more than 20 pounds) unassisted lifting or repeated work at "shoulder level" (90° forward or sideways) or overhead may increase shoulder symptoms due to rotator cuff tendinopathy, rotator cuff tears, inflammatory conditions, ligament sprains, or impingement syndrome.
- Any restrictions are intended to allow for spontaneous recovery or time to (re)build activity tolerance through graded exercise.

As rehabilitation progresses, a gradual reduction in activity limitations is recommended to facilitate full recovery. This generally involves progressive advancement such as no lifting more than 15 pounds for 1 to 2 weeks, then no lifting more than 20 pounds, etc., until the patient returns to normal activities. This is often accomplished in concert with supervised physical or occupational therapy, use

of functional activities and/or home exercise program(s). MDGuidelines provides recommended durations for activity modification after an initial injury. They are targets to provide a guide from the perspective of physiologic recovery and may assist in focusing on return of function (82). Orthopedic surgeons and other specialists often see patients who have failed initial non-operative management and thus might have more patients who fall outside expected targets. For example, post-operative shoulder patients often require greater initial limitations, such as no lifting of any weight and no use of the arm with gradual increased activity.

4. ROTATOR CUFF TENDINOPATHIES

4.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing Shoulder Disorders from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

4.2. OVERVIEW

Degenerative tendinopathy is the primary pathology underlying this closely related group of disorders, whether these conditions are primarily related to aging, insufficient vascular supply to the tendon (248) (249) (250) (251) (252) (253) (416) (417) (418) (419) (420) (421) (422) (423)], and/or mechanical impingement (1024). True myotendinous junction strains are exceedingly rare, estimated at 0.47% of cases (1434). Some have also reported that the symptomatic tears have neovascularization in the critical zone area that has poor blood supply to the tendon which is susceptible to tears (1017), some have reported this in calcific tendinitis (1435), although others have failed to confirm this finding (1436). The majority of rotator cuff tears initiate in the supraspinatus tendon. They can extend posteriorly into the infraspinatus and teres minor or be associated with subscapularis tears. Subscapularis tears can present in isolation. The supraspinatus tendon is prone to degeneration such that it appears that most people develop degenerative tendons over a lifetime (252) (416) (1024)(1030) (1031) (1026) (1033) (1036) (1037) (1038) (1034) (1042) (1043) (999) (1044) (1025) (1045) (1109) (1002)(1005). Among those without shoulder problems, 15% reportedly had full- and 20% had partial-thickness rotator cuff tears with the frequency of tears increasing with age (1033). Another study (1036) found asymptomatic rotator cuff tears overall in nearly one-quarter of the subjects with tears in 13% of the youngest (50 to 59 years), 20% (60 to 69) and 31% (70 to 79) of the middle-aged, and 51% of the oldest (age >80 years); that study concluded that rotator cuff tears should be regarded as "normal' degeneration, not necessarily causing pain and functional impairment." A systematic review exploring the frequencies of rotator cuff tears in asymptomatic and symptomatic persons resulted in aggregate findings are summarized in Table 5 (1031). The prevalence of any asymptomatic tear was approximately 40%, with symptomatic tears occurring from about the same to nearly double the frequency, depending on the method of detection used.

Inflammatory biomarkers have been identified, including interleukin 1β, interleukin 6, cyclooxygenase 2, matrix metalloproteinase (MMP) 9, and vascular endothelial growth factor, and correlate with size of a rotator cuff tear (1437) (1438) (1439) (1440) (1441) (1442) (1443) (1444) (1445). An inheritability index of 18% has been calculated with shared environment of 44% and unique environment of 38% (1446). The supraspinatus tendon has been thought to be susceptible to mechanical impingement within the subacromial space between the head of the humerus and the acromion process. Thus, the term impingement syndrome is also popular, particularly when symptoms are elicited with overhead use (1024), but might not be primary cause of pathology in many rotator cuff syndromes. Tendon and muscle overload on a background of vascular insufficiency is currently thought to be the primary cause of rotator cuff related pathologies. The subacromial and subdeltoid bursae overlie the rotator cuff tendons (1447). Consequently, bursitis or degenerative bursal changes often accompany these conditions.

Table 5. Prevalence of Rotator Cuff Tears in Asymptomatic and Symptomatic Persons As Detected by Ultrasound and MRI

Technique	Asymptomatic/Symptomatic	Number of Scans	Prevalence of Tears (%)		
			Any	Partial	Full
Ultrasound	Asymptomatic	591	38.9	17.2	21.7
	Symptomatic	1038	41.4	6.7	34.7
MRI	Asymptomatic	271	26.2	15.9	10.3
	Symptomatic	490	49.4	8.6	40.8

Adapted from (1031).

Over a 5-year period, 51% of previously asymptomatic tears became symptomatic with a mean of 2.8 years to onset of symptoms in subjects who had documented bilateral rotator cuff tears with one side asymptomatic (1448). The age of the newly found, asymptomatic tears was unknown; however, the average time it took a tear to become symptomatic was over 2.8 years. The relationship between one symptomatic shoulder and the eventual occurrence of symptoms in the asymptomatic shoulder is unknown.

Among 123 patients with unilateral shoulder pain, it was found that nearly all of the findings on MRI in the symptomatic shoulder were also present in the asymptomatic shoulder, with only about 10% more full thickness tears and osteoarthrosis being more prevalent in the symptomatic shoulders (1449).

4.3. DIAGNOSTIC CRITERIA

Patients with rotator cuff tendinopathies have varying clinical presentations; thus, there are no consensus diagnostic criteria that have proven highly accurate. Patients generally have gradual onset, non-radiating glenohumeral joint pain. There are no distal paraesthesias. Rotator cuff tears may present with either acute or gradual onset pain. Impingement signs are often positive.

Research case definitions have included glenohumeral joint pain plus a positive supraspinatus/empty can test (96) (97). Supraspinatus tendon is the most common rotator cuff tears, and tests potentially useful for this diagnosis include resisted external rotation, drop arm, painful arc, full can and empty can tests (98) (55)(99). Evidence to separate full- from partial-thickness tears is weak, with the separation being reportedly difficult and such determinations having poor reliability (100) (58); one

report suggested nearly all tests were unhelpful and only abduction strength was associated with partial tears (101).

Patients are clinically diagnosed based on their history and physical examination. Additional tests are frequently performed on initial evaluation for more severe presentations, but often are not required in mild cases. X-rays are recommended and may be needed of both shoulders, particularly if there is a bilateral injury or need for comparison with the unaffected shoulder. Other studies are often helpful, including MRI and ultrasound, especially for evaluation of potential rotator cuff tears (MRI or US) or SLAP tears (especially MRI).

4.4. WORK LIMITATIONS

Patients with shoulder pain related to tendinopathies should generally be encouraged to perform work activities within limitations of pain. However, some explicit limitations are often needed, especially for more physically demanding work activities. Such limitations are gradually reduced as recovery progresses and most commonly include limitations in heavy lifting and forward flexion and abduction, especially beyond 60 degrees.* As the condition improves, limitations should be reduced or eliminated. Patients with clinically significant rotator cuff tears may need either surgery, or if non-operative management is planned (102) (103) (104). longer duration of workplace limitations to allow for sufficient pain reduction and recovery of sufficient strength. If surgery is performed, there is a similar need for workplace limitations that are gradually reduced.

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*It may be necessary to describe this as not lifting the hand above the shoulder or most commonly no "overhead use." Also, 90 to 120° of abduction and forward flexion is the most compromised biomechanical position for the shoulder in biomechanical experimental studies. Maintaining higher overhead height is less compromising to the shoulder than lowering to 90° if the object cannot be lowered substantially (105) (106) (59).

4.5. DIAGNOSTIC RECOMMENDATIONS

4.5.1. ANTIBODIES

Numerous antibodies are markers for specific rheumatic diseases (e.g., rheumatoid factor, anti-nuclear antibodies, anti-Sm, anti-Ro, anti-La for rheumatoid arthritis, systemic lupus erythematosus, Sjogren's, mixed connective tissue disorder, etc.). Patients with rheumatic disorders are at increased risk for degenerative joint disease of the shoulder as well as subacromial bursitis. Antibodies have been used for the diagnosis of rotator cuff tendinopathies (107)(108). However, ordering of a large, diverse array of anti-inflammatory markers without targeting a few specific disorders diagnostically is not recommended.

ANTIBODIES TO CONFIRM SPECIFIC DISORDERS

Sometimes Recommended

Antibody levels are selectively recommended to evaluate and diagnose patients with shoulder pain that have reasonable suspicion of rheumatological disorders including inflammatory arthropathies.
Antibody levels are strongly recommended as a screen to confirm specific rheumatological disorders when there are indications (e.g., symptoms and/or signs suggestive of rheumatoid arthritis), but are generally not indicated for most patients with other specific soft tissue musculoskeletal disorders, such as rotator cuff tendinopathies due to high false positive rates in that non-specific diagnostic

setting. Consultation with a rheumatologist may be helpful when there is a known or suspected disorder.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Shoulder pain and a presumptive diagnosis of an inflammatory rheumatological disorder. May include pain that fails to respond as would be expected, with or without findings in other joints. Findings in other joints increases the probability that testing will be positive. Testing is generally not indicated for most patients with rotator cuff tendinopathies. Testing is also not generally indicated at initial symptoms presentation unless symptoms have been present for at least a few weeks and/or are severe; otherwise, e.g., negative test results are more likely as insufficient time is likely to have passed and may mislead.

Benefits

Secure an accurate diagnosis, which should then focus the treatment plan to more efficacious treatments.

Harms

Potential for false-positive tests; however that is generally minimal unless the pre-test probability is low.

Frequency/Dose/Duration

Generally only ordered one time. However, if the testing was performed early and there is further disease persistence or progression, a second test is reasonable as more time may be required for the antibody tests to become positive.

Rationale

Elevated antibody levels are highly useful for confirming clinical impressions of inflammatory rheumatological diseases. However, routine use of these tests in shoulder pain patients is not recommended, especially as wide-ranging, non-focused test batteries are likely to result in inaccurate diagnoses due to false positives and low pre-test probabilities. Providers should also be aware that false-negative results occur. Measurement of antibody levels is minimally invasive, unlikely to have substantial adverse effects, and is low to moderately costly depending on the specific test ordered. They are recommended for focused testing of a limited number of diagnostic considerations. However, ordering of a large, diverse array of antibody levels without targeting a few specific disorders diagnostically is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Antibodies; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 9 articles in PubMed using Most Recent tab, and we did a

secondary search in PubMed using Best Match tab to find and review 9 articles, 676 in Scopus, 2 in CINAHL, 1 in Cochrane Library, 119 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.2. NONSPECIFIC INFLAMMATORY MARKERS

There are many markers of inflammation that may be measured serologically in patients (109) (110) (111) (112) (113) (114) (115). These include C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), interleukins, cyclooxygenase 2, matrix metalloproteinases, vascular endothelial growth factor, ferritin, and an elevated total protein-albumin gap. However, ordering of a large, diverse array of anti-inflammatory markers without targeting a few specific disorders diagnostically is not recommended.

NON-SPECIFIC INFLAMMATORY MARKERS FOR SCREENING FOR INFLAMMATORY DISORDERS IN SUBACUTE OR CHRONIC SHOULDER PAIN

Sometimes Recommended

Serum measures of erythrocyte sedimentation rate, C-reactive protein, creatine kinase muscle, aldolase, hyaluronic acid, and other inflammatory markers are selectively recommended for screening either inflammatory disorders with reasonable suspicion of inflammatory disorder in patients with subacute or chronic shoulder pain or osteoarthrosis. They are generally not indicated for patients with non-specific disorders, such as rotator cuff tendinopathies.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Shoulder pain and a presumption of an inflammatory process. Pain that fails to respond as would be expected, with or without findings in other joints. Findings in other joints increases the probability that testing will be positive. Testing is generally not indicated for most patients with rotator cuff tendinopathies. Testing is also not generally indicated at initial symptoms presentation unless symptoms have been present for at least a few weeks and/or are severe; otherwise, e.g., negative test results are more likely as insufficient time is likely to have passed and may mislead.

Benefits

Identify whether an inflammatory process is likely, which may help focus on the need for further testing to secure an accurate diagnosis.

Harms

Potential for false-positive tests; however, that is generally minimal unless the pre-test probability is low.

Frequency/Dose/Duration

Generally only ordered one time. However, if the testing was performed early, and there is further disease persistence or progression, a second test is reasonable as the inflammatory mediators may have needed additional time to become positive.

Rationale

Erythrocyte sedimentation rate (ESR) is the most commonly used systemic marker for non-specific inflammation. It is elevated in numerous inflammatory conditions including rheumatological disorders as well as infectious diseases. C-reactive protein (CRP) is a marker of systemic inflammation that has been associated with an increased risk of coronary artery disease. It is also a non-specific marker for other inflammation. Both ESR and CRP are also markers of infection. Numerous inflammatory markers have been found to be elevated in patients with musculoskeletal disorders but because it is not known whether these factors precede or are a consequence of the disease processes, their utility in patient management is unclear. Other non-specific markers of inflammation include elevated ferritin and an elevated protein-albumin gap, neither of which have known clinical roles. Serological studies for non-specific inflammatory markers are minimally invasive, have low risk of adverse effects, and are low cost. They are recommended as a reasonable screen for systemic inflammatory conditions especially if the patient also has other pain without clear definition of a diagnosis or those with fibromyalgia or myofascial pain syndrome, although specificity is not high. However, ordering of a large, diverse array of anti-inflammatory markers without targeting a few specific disorders diagnostically is not recommended.

A large study found elevated biomarkers (C-reactive protein, creatine kinase muscle, aldolase) are associated with osteoarthrosis compared with normal controls (Ganguly, 2019). Another study found elevated serum hyaluronic acid levels among both those with either rheumatoid arthritis or osteoarthrosis, although the HA levels were higher among those with rheumatoid arthritis (Goldberg RL, 1991) and TNF alpha, IL-1B, IL-10 and IL-17 (Hussein et al., 2008). However, clear distinctions between these measures among those with osteoarthrosis and inflammatory arthropathies is not apparent in the available literature. Thus, the utility of these tests may be as potential screening for arthropathies irrespective of inflammatory arthroses.

A high-quality, 7-year study of 880 elderly subjects evaluated impacts of IL-6 and CRP on both cross-sectional associations with morbidity and long-term mortality (Taaffe DR, 2000). CRP and IL-6 were higher among smokers at baseline and those with higher body mass indexes (BMIs). IL-6 and CRP were also higher among those with hypertension, myocardial infarction, stroke, glycosylated hemoglobin levels, HDL, and number of chronic conditions. Both IL-6 and CRP were inversely related to quartiles of moderate and strenuous physical activity. CRP and/or IL-6 were associated with incidence of hypertension, myocardial infarction, diabetes, and incident cases of chronic conditions. Physical performance measures of changes in grip strength, signature time, chair-rise and 6-m fast walk all were not significant for IL-6 or CRP.

Serological studies for non-specific inflammatory markers are minimally invasive, have low risk of adverse effects, and are low cost. They are recommended as a screen for systemic inflammatory and osteoarthrosis conditions especially if the patient also has other pain without clear definition of a diagnosis, although specificity is not high and these measures tend to be elevated in both osteoarthrosis and inflammatory disorders, with higher levels among those with inflammatory disorders. However, ordering of a large, diverse array of anti-inflammatory markers without targeting a few specific disorders diagnostically is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: blood sedimentation, c reactive protein, procalcitonin, nonspecific inflammatory markers; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 6 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 6 articles, 756 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 11,000 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 6 from Google Scholar, and 0 from other sources. Of the 8 articles considered for inclusion, 5 diagnostic studies and 0 systematic reviews met the inclusion criteria.†

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cytokines; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 12 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 12 articles, 1030 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 12,000 in Google Scholar, and 0from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.†

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: C-Reactive Protein, Erythrocyte Sedimentation Rate, Non-Specific Inflammatory Markers; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 35 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 37 articles, 61 in Scopus, 10 in CINAHL, 3 in Cochrane Library, 171 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.3. CYTOKINES

Cytokines have been used to attempt to diagnose problems with the rotator cuff (116) (117) (118) (119) (120) (121) (122) (123) (124) (125).

CYTOKINE TESTING FOR CHRONIC SHOULDER PAIN, INCLUDING ROTATOR CUFF TENDINOPATHIES

Not Recommended

Routine testing with or the use of batteries of cytokine tests is not recommended to diagnose chronic shoulder pain, including rotator cuff tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Cytokines purportedly determine whether a patient is experiencing pain or has suffered a toxicological insult. However, there are no quality studies that address this premise. Available studies suggest that these markers may be elevated in chronic pain conditions, but these studies did not have adequate control groups and did not control for potential confounders. The range of disorders in which cytokines may be elevated also needs definition, as the current range of conditions appears large (Taaffe DR, 2000, Martelletti, 1999, Perini, 2005, Covelli, 1991, Gratt, 2005, Alexander, 1998, Chen, 2004, Gur, 2002, Madson, 1994), suggesting they are not specifically isolated to patients with chronic pain, and thus the specificity of these tests seems likely to be quite low.

A high-quality, 7-year study of 880 elderly subjects evaluated impacts of IL-6 and CRP on both cross-sectional associations with morbidity and long-term mortality (Taaffe DR, 2000). CRP and IL-6 were higher among smokers at baseline and those with higher body mass indexes (BMIs). IL-6 and CRP were also higher among those with hypertension, myocardial infarction, stroke, glycosylated hemoglobin levels, HDL, and number of chronic conditions. Both IL-6 and CRP were inversely related to quartiles of moderate and strenuous physical activity. CRP and/or IL-6 were associated with incidence of hypertension, myocardial infarction, diabetes, and incident cases of chronic conditions. Physical performance measures of changes in grip strength, signature time, chair-rise and 6-m fast walk all were not significant for IL-6 or CRP. Cytokines need to be rigorously studied to ascertain if there is a place for them in the evaluation and/or management of chronic pain conditions, including stratification for occupationally-relevant diseases.

Documentation that the discovery of elevated cytokine levels results in changes in evaluation and/or clinical management is also necessary. Alternatively, this testing may be useful if the absence of elevated cytokine levels would warrant concluding that a patient does not have a remediable physical cause of shoulder pain. While cytokine testing is minimally invasive, and has a low risk of adverse effects, these tests are high cost, with no evidence that they alter the clinical management of patients with chronic shoulder pain. Their place in the evaluation of patients with chronic shoulder pain is yet to be determined and cytokine testing is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cytokines, Interleukins, Chemokines and lymphokines; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value,

predictive value of tests, efficacy, efficiency. We found and reviewed 56 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 76 articles, 545 in Scopus, 12 in CINAHL, 1 in Cochrane Library, 218 in Google Scholar, and 0 from other sources†. We considered for inclusion 5 from PubMed, 2 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 8 articles considered for inclusion, 0 diagnostic studies and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.4. X-RAYS

X-rays show bony structures and are the initial test for evaluation and diagnosis of many cases of shoulder pain (126) (127) (128) (129) (130) (131) (132) (133) (134) (135) (136).

X-RAYS FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN, INCLUDING ROTATOR CUFF TENDINOPATHIES

Recommended

X-rays are recommended for evaluation of acute, subacute, or chronic shoulder pain.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Most patients with shoulder pain are candidates for x-rays, especially for significant trauma, pain without trending towards improvement, impaired use, and those with red flags. Most patients with rotator cuff tendinopathies do not require x-rays, although ongoing symptoms warrant x-rays, especially to ascertain calcific tendinitis which has some differences in management. Age has been found to be a potent predictor of increased degenerative changes found on x-ray in the acromioclavicular joint (Bonsell et al., 2000). Reportedly, x-ray has been helpful for diagnosing os acromiale in shoulder pain patients who were otherwise thought to not have the condition (Burbank et al., 2007).

Benefits

Diagnosis of a fracture, calcific tendinitis, or otherwise latent medical condition(s).

Harms

Medicalization or worsening of otherwise benign shoulder condition; minor radiation exposure.

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient with two to three views. For patients with chronic shoulder pain, it may be reasonable to obtain a second set of x-rays later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

X-ray studies do not generally assess the value of x-rays in the diagnosis and management of patients. Instead, most comparative studies including x-rays compare with MRI or US and generally found the other diagnostic studies superior, especially for MRI. A few quality studies suggest x-rays are helpful in the evaluation of rotator cuff tears (Zhang et al., 2016, Hussain et al., 2018) and to evaluate most patients with shoulder pain, both to diagnose and to assist with the differential diagnostic possibilities such as tendinopathies and arthroses. However, x-rays are not necessary to manage most patients with rotator cuff tendinopathies as they do not change the initial management; yet, x-rays are particularly helpful for diagnosis of calcific tendinitis, which results in different treatment options if the pain persists. They may also help to suggest soft tissue pathology, including large chronic rotator cuff tears.

As x-ray has been performed for more than 120 years as a diagnostic procedure, it is unsurprising that there is little quality evidence to support its use. The threshold for also ordering x-rays of the cervical spine and/or elbow joint should be low, particularly if the findings on shoulder x-ray are either normal or do not readily explain the degree of abnormality. Patients with shoulder pain might show greater tuberosity osteopenia, cystic degenerative changes, and spurring, thought to be a marker of chronicity of rotator cuff tears (Cadet et al., 2008). Glenohumeral arthrosis is also more likely if there is a full-thickness rotator cuff tear (Gartsman et al., 1997). Plain radiographic findings are used to stage disease involvement in osteonecrosis or humeral avascular necrosis. Early x-rays are usually normal or have less distinct trabecular patterns since the living part of the bone does not image (Harreld et al., 2009, Ficat, 1985). As the disease progresses, x-rays begin to show osteoporotic areas, progressing to sclerotic areas and finally flattening and bony collapse (Ficat, 1985, Bryant et al., 2002). X-rays are non-invasive, low to moderate costly, and have little risk of adverse effects, and therefore are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Roentgenograms; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 1649 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 2180 articles, 95 in Scopus, 104 in CINAHL, 57 in Cochrane Library, 96 in Google Scholar, and 0 from other sources†. We considered for inclusion 7 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 9 articles considered for inclusion, 4 diagnostic studies and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.5. DIAGNOSTIC ARTHROSCOPY

Arthroscopy has been used for diagnosis and as the initial part of a therapeutic surgical treatment procedure, including rotator cuff tendinopathies (137) (138) (139) (140) (58) (141) (142) (143) (144) (145).

DIAGNOSTIC ARTHROSCOPIC SURGERY FOR SHOULDER PAIN, INCLUDING ROTATOR CUFF TENDINOPATHIES

Recommended

Diagnostic arthroscopy is recommended for evaluation of select patients with shoulder pain (see indications), including subsequent, definitive operative approaches including rotator cuff tendinopathies.
Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

Rotator cuff tear with surgical indications and the expectation that surgical treatment will immediately follow arthroscopy in the same procedure. This is commonly performed for full-thickness rotator cuff tears which are thought to be acute and have accompanying significant functional deficits. When there are fewer functional deficits and/or for partial thickness tears, it is generally not performed until after at least 1 trial of physical or occupational therapy (emphasizing exercises) and at least one glucocorticosteroid injection. Arthroscopy is also commonly performed for: 1) labral tear with surgical indications (see below); 2) impingement syndrome with surgical indications (see below); 3) glenohumeral instability, 4) recurrent dislocations, 5) labral tears, 6) other moderate or severe shoulder joint pain, acromioclavicular arthritis, or mechanical symptoms with substantially reduced ROM or functional impairment.

Benefits

Diagnostic confirmation and the opportunity for definitive treatment

Harms

Infections, operative complications

Frequency/Dose/Duration

Arthroscopy would rarely be repeated other than for new
Indications

Rationale

There are quality studies including arthroscopy, however the literature usually utilizes arthroscopy as the gold standard for comparison. Arthroscopy is performed nearly universally in a context of a pre-operative diagnosis, such as rotator cuff tendinopathy, that is thought to be a treatable abnormality, rather than merely for diagnostic purposes (Dinnes et al., 2003, Fouse et al., 2007, Abrams, 2006,

Baker et al., 2003, Ahmad et al., 2004, Boszotta et al., 2004). If a specific diagnosis such as rotator cuff tendinitis is not suggested by and supported by the evaluation with history, physical examination, and imaging studies, then surgical intervention is much less likely to be successful and caution should be taken in doing a purely diagnostic arthroscopy. Arthroscopy has been shown to be superior to MRI especially subscapularis tears (Ward et al., 2018), and ultrasound for diagnosing partial thickness rotator cuff tears and infraspinatus and subscapularis tears (Singisetti et al., 2011, Teefey et al., 2000, Ward et al., 2018, Ostor et al., 2013). Arthroscopy has been used to evaluate glenohumeral arthrosis (Guyette et al., 2002) (see below). Some caution is indicated because intrasubstance tears are not well visualized arthroscopically. There are no quality studies of arthroscopy for diagnostic purposes due to many methodological weaknesses in the available literature (Dinnes et al., 2003). It appears helpful for diagnosis and subsequent operative approaches (Baumann et al., 2008, Bishop et al., 2003). Diagnostic arthroscopy is invasive, has adverse effects and is high cost. However, in select patients there may be no other option for addressing the condition if a patient is not responding to conservative care. Additionally, it is highly useful for operative planning and to help determine whether arthroscopic repair is an appropriate approach for a rotator cuff tear repair or instability surgery. Thus, arthroscopy is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Shoulder Arthroscopy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 173 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 213 articles, 780 in Scopus, 55 in CINAHL, 90 in Cochrane Library, 304 in Google Scholar, and 2 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 3 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 5 articles considered for inclusion, 5 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.6. BONE SCANS

Bone scans involve intravenous administration of Technetium Tc-99m that is preferentially concentrated in areas of boney metabolic activity. There are many causes for abnormal radioactive uptake; thus, positive bone scans are not highly specific. Bone scans have been used for diagnosis of early osteonecrosis of the humeral head prior to findings on x-ray, among other uses.

BONE SCANNING FOR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Bone scanning is not recommended for evaluation of typical rotator cuff tendinopathies. There are other uses for bone scans, particularly osteonecrosis, and other conditions with increased bone metabolism.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

Bone scanning may be a helpful diagnostic test to evaluate suspected metastases (multiple sites), infected bone (osteomyelitis), inflammatory arthropathies, and trauma (e.g., occult fractures), particularly if MRI is not available or is contra-indicated. It may be helpful in those with suspected, early osteonecrosis (avascular necrosis) without x-ray changes. In cases where the diagnosis is felt to be secure, there is no indication for bone scanning as it does not alter the treatment or management. There is no clear indication for bone scanning for typical rotator cuff tendinopathies. Bone scanning is minimally invasive, has minimal potential for adverse effects (essentially equivalent to a blood test), but is high cost.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Bone scans, Skeletal Scintigraphy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 60 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 202 articles, 532 in Scopus, 8 in CINAHL, 8 in Cochrane Library, 1230 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.7. COMPUTED TOMOGRAPHY (CT)

Computerized tomography remains an important imaging procedure, particularly for bony anatomy, whereas MRI is superior for soft tissue abnormalities. However, most patients have issues with soft tissue rather than bony abnormalities in the shoulder; thus on a population-basis, far fewer CT scans are ordered. CT may nevertheless be useful for shoulder joint abnormalities where advanced imaging of the bones is required (i.e., complex proximal humerus fracture, scapular fracture). CT also may be useful to evaluate the anatomy in patients with contraindications for MRI (most typically an implanted metallic-ferrous device). CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – glenoid deficiency and humeral Hill-Sachs – as MRI is inferior for bone imaging. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear (146).

CT FOR EVALUATION OF ROTATOR CUFF TENDINOPATHIES

Not Recommended

Computerized tomography is not recommended for the evaluation of rotator cuff tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

MRI is considered superior to computerized tomography for imaging most shoulder abnormalities where advanced imaging of soft tissues is usually the primary concern. This is especially so with rotator cuff tendinopathies. However, where imaging calcified structures is required, CT is considered superior. This includes complex proximal humeral and glenoid/scapular fractures. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear, especially if there is a contraindication to MRI. A contrast CT study is minimally invasive, has few, if any, adverse effects but is costly. It is not recommended for evaluation of rotator cuff tendinopathies.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Computerized Tomography; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 9680 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 12504 articles, 2845 in Scopus, 43 in CINAHL, 284 in Cochrane Library, 446 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.8. ELECTROMYOGRAPHY

See the Cervical and Thoracic Spine Disorders and Hand, Wrist, and Forearm Disorders for discussions regarding use of electrodiagnostic studies for evaluation of cervical spine and distal upper extremity-related disorders that may present as shoulder pain. Electrodiagnostic studies have also been used to confirm diagnostic impressions of other peripheral nerve entrapments, brachial plexopathies, and neurologic component of thoracic outlet syndrome (147) (148).

4.5.9. FUNCTIONAL CAPACITY EVALUATIONS

Functional capacity evaluations (FCEs) consist of a comprehensive battery of performance-based tests to attempt to determine an individual's ability for work and activities of daily living (149) (150) (151)

(152) (153) (154) (155) (156) (157) (158) (159) (160) (161) (149) (162) (163) (164) (165) (166) (167) (168) (169) (170) (171)(172). The goals of FCEs include:

- Determining an individual's readiness to work after injury or illness at Maximum Medical Improvement (MMI),
- Assisting with goal-setting and treatment planning for rehabilitation or to monitor the progress of a patient in a rehabilitation program,
- Estimating the potential vocational status and providing a foundation for effective vocational rehabilitation,
- Providing information to assist in disability determinations,
- Providing information for hiring decisions (post-offer or fit-for-duty testing),
- Providing information for developing work restrictions
- Assessing the extent of disability in litigation cases, and
- Providing information regarding a patient's level of effort and consistency of performance.

FUNCTIONAL CAPACITY EVALUATIONS FOR CHRONIC DISABLING SHOULDER PAIN

Recommended

Functional capacity evaluations (FCEs) are recommended as an option for evaluation of disabling chronic shoulder pain where the information may be helpful to attempt to objectify worker capability, function, motivation, and effort vis-à-vis either a specific job or general job requirements. There are circumstances where a patient is not progressing as anticipated at 6 to 8 weeks and an FCE may help evaluate functional status and patient performance in order to match performance to specific job demands, particularly in instances where those demands are medium to heavy. If a provider is comfortable describing work ability without an FCE, there is no requirement to do this testing. Recordings or observation for signs of mismatch between effort and self-reported abilities may be particularly helpful.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Patients with moderate to severe chronic shoulder pain that has ongoing functional impairments and need to attempt to identify and quantify limitations. There are circumstances where a patient is not progressing as anticipated at 6 to 8 weeks and an FCE can evaluate functional status and patient performance in order to match performance to specific job demands, particularly in instances where those demands are medium to heavy. More typically, FCEs are useful after a healing plateau is established whether surgery was performed or not. If a provider is comfortable describing work ability without an FCE, there is no requirement to do this testing. Recordings or observation for signs of mismatch between effort and self-reported abilities may be particularly helpful.

Benefits

Identification and enumeration of limitations. Assess functional abilities and may facilitate greater confidence in return to work.

Harms

Inappropriately low estimates of abilities, self-limitation of efforts, excessive disability, inappropriately precluding the performance of tasks and activities the person could safely perform. Medicalization, worsening of shoulder pain with testing; may have misleading results that understate capabilities.

Frequency/Dose/Duration

Generally, only one test is needed. A repeat FCE may be needed if there are substantial changes in the person's condition or status, or if there is a need to assess projected performance against a different set of job criteria.

Rationale

There are no quality studies of FCEs to evaluate ability to perform work and/or work limitations. Yet, FCEs are one of the few means to attempt to objectify limitations and are frequently used in workers' compensation systems, particularly as the correlation between clinical pain ratings and functional abilities appears weak (Brouwer et al., 2005, Gross et al., 2003, Reneman et al., 2002, Reneman et al., 2007, Schiphorst Preuper et al., 2008, Smeets et al., 2007, Eriksen et al., 2006). However, obtaining objective data regarding shoulder problems is somewhat more challenging than for distal upper extremity-related impairments due to the degree of reliance on the patient's subjective willingness to exert or sustain major activities that are critical for job performance. Because their reliability and validity have not been proven, FCEs should be utilized to evaluate work ability about what a patient was willing to do on a given day. They should be carefully performed and interpreted, but FCEs should not be used to override the judgment about the work ability of a patient with a shoulder problem.

Many commercial FCE models are available. There is research regarding inter-and intra-rater reliability for some of the models (complete discussion is beyond the scope of this guideline). The validity of FCEs, particularly predictive validity, is more difficult to determine, since factors other than physical performance may affect return to work (Pransky et al., 2004, Gouttebarge et al., 2004). An FCE may be done for one or more reasons, including identifying an individual's ability to perform specific job tasks associated with a job (job-specific FCE) and physical activities associated with any job (general FCE), or to assist in the objectification of the degree(s) of impairment(s). The type of FCE needed, and any other issues the FCE evaluator needs to address, should be specified when requesting an FCE.

The term "capacity" used in FCE may be misleading, since an FCE generally measures an individual's voluntary performance rather than his or her capacity. Physical performance is affected by psychosocial as well as physical factors. The extent of an individual's performance should be evaluated as part of the FCE process through analysis of his or her level of physical effort (based on physiological and biomechanical changes during activity) and consistency of performance. Perhaps more importantly, the objective findings identified in the musculoskeletal evaluation should correlate with any identified functional deficits. The individual's performance level, especially as it relates to stated levels of performance, should be discussed in the FCE report. A properly performed and well-reported FCE will highlight such discrepancies. This is particularly important in shoulder evaluations where there may be greater degrees of impairments at stake and where there are somewhat fewer metrics available than for the distal upper extremity.

FCE test components may vary depending on the model used, but most contain the following:

- Patient interview including: informed consent, injury/illness and medical history, current symptoms, activities and stated limitations, pain ratings/disability questionnaires
- Musculoskeletal examination (e.g., including analogues of Waddell's non-organic signs for the shoulder such as non-anatomic pain)

- Observations throughout the session (e.g., demonstrated sitting tolerance, pain modifying behaviors)
- Material handling tests (lifting, carrying, pushing, pulling)
- Movement tests (walking, crouching, kneeling, reaching, etc.)
- Positional tolerance tests
- Dexterity/hand function
- Static strength (varies among models)
- Aerobic fitness (usually submaximal test-also variable among models)
- Job-specific activities as relevant
- Reliability of client reporting (e.g., non-organic signs, pain questionnaires, placebo tests, etc.)
- Physical effort testing (e.g., Jamar Dynamometer maximum voluntary effort, bell curve analysis, rapid exchange grip, competitive test performance, heart rate, observation of clinical inconsistencies, etc.)

FCE test length may vary between FCE models, although most 1-day FCEs are completed in 3 to 4 hours. Two-day tests, where the patient is seen on 2 consecutive days, may be recommended when there are problems with fatigue (e.g., chronic fatigue syndrome), delayed onset of symptoms, unusually complex job demands to simulate, and questions about symptom validity. Test length for 2-day tests is generally 3 to 4 hours on the first day, and 2 to 3 hours on the second day.

Interpretation of FCE results is complicated in that it is a measure of voluntary performance. Before beginning testing, the patient is counseled to avoid doing anything to knowingly reinjure him or herself. Thus, “fear avoidance” may cause testing to seriously underestimate actual ability and result in a report that the patient had “self-limited performance due to pain,” suggesting a low pain tolerance, when in reality the patient was doing what he or she was instructed.

By analogy, the best studies on the ability of FCEs to predict safe re-entry to the workplace following rehabilitation of work-related back pain/injury suggest that FCEs are not able to predict safe return to work (concurrent validity) (Gross et al., 2005, Gross et al., 2004, Gross et al., 2004). In a prospective cohort study of 1,438 consecutive work-related back patients, all underwent an FCE prior to return to work. In the control group, the FCE was used to write return-to-work guidelines, while in the study group it was ignored and the worker was returned usually to full duty. Ignoring the FCE improved outcome (Hall et al., 1994).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Functional Capacity Evaluations; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 6 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 34 articles, 42 in Scopus, 8,289 in CINAHL, 11 in Cochrane Library, 334 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.10. MAGNETIC RESONANCE IMAGING (MRI)

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for rotator cuff tendinopathies and many other shoulder joint problems since it tends to be helpful for imaging soft tissues, particularly the rotator cuff (591) (592) (184) (593) (594) (595) (57) (596) (597) (598) (599) (600) (601) (58) (1450) (1451) (1452) (1453) (1454) (1455) (1456) (1457) (1458) (1459) (1460) (1461) (1462) (1463) (1464) (1465) (1466) (55) (1467) (1468) (1469) (274) (1470) (552) (1471) (1472) (1473) (1474) (185) (1475) (1476) (1477) (1478) (1479) (1480) (1481) (1482) (1483) (1484).

MRI FOR DIAGNOSING ROTATOR CUFF TENDINOPATHIES

Recommended

MRI is strongly recommended for patients suspected of having acute, clinically significant rotator cuff tears. It is also recommended for select patients with subacute or chronic shoulder pain thought to potentially have a symptomatic rotator cuff tear.
Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

Indications

Patients thought to have an acute, clinically significant rotator cuff tear or subacute or chronic shoulder pain suspected of having a clinically meaningful rotator cuff tear. MRI may also be helpful with chronic rotator cuff tendinopathies, and impingement syndrome. If there is significant rotator cuff weakness, immediate imaging may be indicated. Exceptions include elderly patients, those who would not undergo surgical repair, or those who have substantial signs of pre-existing large/massive rotator cuff tear. It is also reasonable to wait for 1 or 2 weeks to ascertain whether the condition is likely to resolve with conservative care without obtaining an MRI. Most acute tears without significant weakness should wait 2+ weeks prior to imaging as some patients with acute pain and limited ROM resolve clinically. Those with subacute or chronic pain should generally have failed additional non-operative treatment including NSAID, exercise, and injection(s).

Benefits

Secure a diagnosis.

Harms

False positives and false negatives for rotator cuff tears.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

There is strong evidence, with many high-quality studies having compared ultrasound (US) to MRI. Although a few have reported comparable detection of full-thickness tears (Iannotti et al., 2005), studies have consistently reported superiority of MRI to US for the detection of partial-thickness tears (Ardic et al., 2006). One moderate-quality study compared MRI with arthrography, suggesting MRI is superior to arthrography (Blanchard et al., 1999); however, arthrography alone has been largely replaced by other procedures. MRI has also been compared with arthroscopy in 57 patients with shoulder pain of unclear cause (Torstensen et al., 1999). MRI was found to be accurate in detecting 68% of rotator cuff (RC) tears and 62% accurate in detecting labral injuries. MRI sensitivity for RC tears was 96% and specificity 49% (for labral tears, 73% sensitive, 58% specific). MRI was compared with arthroscopic findings among 16 patients with trauma (Kirkley et al., 2003). The authors found moderate correlation for superior labral lesions (k = 0.60), fair agreement for rotator cuff tear (k = 0.355), Hill-Sachs (k = 1.0), and moderate for size (k = 0.44). A consecutive case series of 104 patients with shoulder problems were evaluated and randomized to MRI first versus arthrography first. There were modestly fewer changes in diagnostic categories with MRI (30%) than arthrography (37%), p >0.5. MRI led to slightly more changes in planned therapy (36% vs. 25%, p >0.3). MRI was found to be 79% accurate, 81% sensitive and 78% specific for full-thickness rotator cuff tears. Arthrography was found to be 82% accurate, 50% sensitive and 96% specific (Blanchard et al., 1999). A cross-sectional comparison of MRI (1.5T loop-gap resonator surface coil), double contrast arthrography, high resolution sonography and surgery among 38 patients with suspected rotator cuff tears did not include all patients receiving all tests or surgery (other than MRI and arthrography) and reported a sensitivity of MRI of 100% (Burk et al., 1989). Ultrasound detected 9/15 (60%) of tears. However, the study population was small and biased in favor of overestimating the tests' sensitivity.

MRI has shown increased changes in the rotator cuff and tears with increased age (Needell et al., 1996, Sher et al., 1995), as well as a high prevalence of bony and peritendinous shoulder abnormalities among those without symptoms (Needell et al., 1996). MRI has reasonably good operant characteristics for full-thickness tears, although it does not have good sensitivity for partial thickness tears (Dinnes et al., 2003). Fatty infiltration of the rotator cuff tendons is also found on MRI and thought to signify chronicity as well as portending a poorer surgical outcome (Berhouet et al., 2009). A comparative assessment of T-2 weighted fast spin-echo technique with vs. without fat-suppression MRI for assessment of rotator cuff tears among 177 patients thought to have tears found no differences in assessments of complete tears, but differed in interpretations of partial tears (Singson et al., 1996). Compared with surgery, sensitivity was 100% for full-thickness tears and specificity for intact tendons was 86%. Fat suppression was felt helpful for partial tears. MRI demonstrates acromial abnormalities and there is a higher prevalence of Type 3 acromion processes among those with either rotator cuff tear or impingement syndrome (Epstein et al., 1993). It has been suggested increased T2 signal in the distal clavicle may be an indication for surgical resection.

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for many shoulder joint problems since it tends to be helpful for imaging soft tissues, particularly the rotator cuff (Mulyadi et al., 2009, Chang et al., 2006, Ardic et al., 2006, Tuite et al., 2000, Connell et al., 1999, McFarland et al., 2009, Pandya et al., 2008, Cartland et al., 1992, Chang et al., 2008, Tirman et al., 1994, Wnorowski et al., 1997, Tung et al., 2000, Reuss et al., 2006). Although studies are not heterogeneous, pooled estimates of the sensitivity for full-thickness tears has been calculated and is 89% with specificity 93%, while for partial thickness tears, these estimates are only 44% sensitivity and 90% specificity (Dinnes et al., 2003). Similarly, accuracy is lower for smaller than larger tears. There are concerns that MRI is

inferior to MR arthrography for evaluating the labrum (Schmerl et al., 2005); thus, MRA is recommended for evaluation of the joint.

MRI is not invasive, has potential adverse effects from issues of claustrophobia or complications of medication, and is costly. MRI is not recommended for routine shoulder imaging, but it is recommended for evaluation of rotator cuff tears.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnetic resonance Imaging; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 1860 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 2297 articles, 7290 in Scopus, 231 in CINAHL, 47 in Cochrane Library, 937 in Google Scholar, and 2 from other sources†. We considered for inclusion 18 from PubMed, 6 from Scopus, 4 from CINAHL, 1 from Cochrane Library, 2 from Google Scholar, and 9 from other sources. Of the 40 articles considered for inclusion, 12 diagnostic studies and 7 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.11. MAGNETIC RESONANCE ARTHROGRAM (MRA)

Magnetic resonance (MR) arthrography combines and MRI with an arthrogram to overcome MRI limitations and is usually performed in preference to CT arthrography unless bony structure definition is needed as well (173) (174). MR arthrography is particularly thought to be effective for imaging labral pathology (175) (176) (177) (178) (179) (180) (43) (181). Magnetic resonance arthrogram has been used to diagnose rotator cuff tendinopathies (182) (183).

MR ARTHROGRAM (MRA) FOR SELECT DIAGNOSIS OF ROTATOR CUFF TENDINOPATHIES

Recommended

MR arthrography is recommended for diagnosing articular side partial-thickness rotator cuff tears, subscapularis tears, and labral tears in select patients with subacute or chronic shoulder pain.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients with subacute or chronic shoulder pain with symptoms or clinical suspicion of rotator cuff tendinopathies or tears, impingement, and subacromial bursitis or other concerns about the shoulder joint requiring MR imaging. MR arthrograms are generally not necessary for uncomplicated rotator

cuff tendinopathies; however, they are indicated if there are concerns regarding concomitant labral tears. Those with subacute or chronic pain should generally have failed additional non-operative treatment including NSAID, exercise and injection(s).

Benefits

Secure a diagnosis.

Harms

False positives and false negatives; however, arthrography improves the accuracy, especially regarding complete rotator cuff tears and significant labral tears. Small risk of infection and complications from the injection.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

MR arthrograms have not been evaluated in large-scale quality studies to assess their utility for the diagnosis of rotator cuff tendinopathies. Although studies are heterogeneous, pooled estimates of the sensitivity for full-thickness tears have been estimated to be 95% with a specificity of 93% (Dinnes et al., 2003). There is high prevalence for labral injury with a first shoulder dislocation based on MR arthrography (MRA) (Antonio et al., 2007). One study suggested that stand-alone MRA is not sufficient for diagnosing calcific tendinitis (Zubler et al., 2007). Arthrography with low-field MR was found to be equivalent to high-field in a series of 38 patients (Loew et al., 2000). A comparison of high- versus low-field MR imaging for SLAP tears among symptomatic patients found high field superior for diagnosing SLAP (Tung et al., 2000). The sensitivity of high-field MRA was 90% and specificity 63%, while sensitivity for low field was 64% and 70% specificity. MRA was found superior to CT arthrography (CTA) and marginally better than MRI for identification of labral tears in a case series of patients with recurrent anterior instability, prior anterior dislocation or shoulder pain of unknown cause (Chandnani et al., 1993). MRA sensitivity for a labral tear was 96.4%, MRI was 92.9%, and CTA was 73.1%. Specificity was 100% for all three tests; however, this appears overstated as there were only two patients without a tear in this small case series.

MR arthrography is invasive; has adverse effects including a low, but definite, risk of infection; and is painful. It is also costly, although MRA has been felt to provide better cost-effectiveness than MRI or CT arthrography for select diagnoses (Oh et al., 1999). It is likely the best imaging procedure available for patients thought to have labral tears or patients with good strength in order to assess the labrum and rotator cuff with traumatic injury simultaneously and is recommended for select use.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: magnetic resonance arthrogram, MRA; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value

of tests, efficacy, efficiency. We found and reviewed 202 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 250 articles, 129 in Scopus, 9 in CINAHL, 19 in Cochrane Library, 590 in Google Scholar, and 1 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 3 articles considered for inclusion, 3 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.12. ULTRASOUND

Diagnostic ultrasound has been used for evaluating rotator cuff tears (184) (185) (186) (187) (188) (189) (190) (191) (192).

ULTRASOUND FOR DIAGNOSING ROTATOR CUFF TENDINOPATHIES

Sometimes Recommended

Ultrasound is recommended for selective use on patients suspected of having full-thickness rotator cuff tears.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Ultrasound operators should have sufficient skill to obviate the need for MRI or CT scanning (Boykin et al., 2010, Hanchard et al., 2013); otherwise, the test introduces unnecessary redundancy. Patients with symptoms and signs of a clinically significant acute, full-thickness rotator cuff tear or subacute or chronic shoulder pain suspected of having a symptomatic rotator cuff tear (Ardic et al., 2006, Wall et al., 2012, Ianotti, 2005, Naredo et al., 1999). Patients thought to only have a partial-thickness tear are generally not good candidates for US as MRI is shown to be superior (Ardic et al., 2006, Wall et al., 2012, Roberts et al., 2001, Sipola et al., 2010, Naredo et al., 1999). Most clinical presentations should wait approximately 2 weeks prior to imaging because some patients with acute pain and limited range of motion resolve clinically; obvious tears are an exception to waiting 2 weeks. Those with subacute or chronic pain should generally have failed additional non-operative treatment including NSAIDs, exercise, and injection(s) (Moosikasuwan et al., 2005, Ottenheijm et al., 2010). An MR arthrogram is recommended for suspected labral injury (see below) (Ardic et al., 2006).

Benefits

Secure a diagnosis.

Harms

False positives and false negatives.

Frequency/Dose/Duration

Repeat ultrasound should be based on significant change in symptoms and/or examination findings.

Rationale

Many high-quality studies have compared US to MRI. Although a few have reported comparable detection of full-thickness tears (Frei et al., 2008, Ianotti, 2005), studies consistently report superiority of MRI to US for the detection of partial thickness tears (Ardic et al., 2006, Wall et al., 2012, Roberts et al., 2001, Sipola et al., 2010, Naredo et al., 1999); thus, US is generally not indicated for use in patients thought to have a partial-thickness tear.

Ultrasound has been compared with physical examination findings, suggesting physical exam identified fewer abnormalities compared with ultrasound, although there was not clinical correlation with treatment outcomes (Kim et al., 2007). Ultrasound utilized to evaluate asymptomatic shoulders found increased prevalence of full-thickness tears with increased age (Sher et al., 1995, Tempelhof et al., 1999); with approximately 6% among 212 individuals (Schibany et al., 2004) and in 7.6% of 420 (Moosmayer et al., 2009). Asymptomatic tears increase in prevalence by age – 50 to 59 years (2.1%) versus 60 to 69 years (5.7%) versus 70 to 79 years (15%) (Moosmayer et al., 2009). Ultrasound is thought to be relatively effective for identifying full-thickness tears (Iannotti et al., 2005, Ottenheijm et al., 2010, Hedtmann et al., 1995, Zehetgruber et al., 2002, Brenneke et al., 1992, Furtschegger et al., 1988, Mack et al., 1988, Mack et al., 1988, Middleton et al., 1986, Smith et al., 2011, Awerbuch, 2008); however, it appears somewhat less effective for identifying partial-thickness tears (Naredo et al., 1999, Brenneke et al., 1992, Awerbuch, 2008, Buchbinder et al., 2013). A surgical case series of 42 patients attempted to determine the diagnostic accuracy of ultrasound. Ultrasound detected all full-thickness tears (100% sensitive, 97% specific), but only 6 of 13 of the partial-thickness tears (46% sensitive, 97% specific). One full-thickness tear was falsely diagnosed. Another study has suggested sensitivity for detection of tear size of 83 to 86% (Ianotti, 2005). Ultrasound has advantages of being able to move the arm actively or passively during the examination; it is less expensive; and it may be available in most centers (Boykin et al., 2010). When conservative treatment failed, skilled physician's using ultrasound reportedly had high diagnostic accuracy identifying tendinopathy, calcifying tendonitis, and partial- and full- thickness tears (Ottenheijm et al., 2010). SLAP lesions cannot be well visualized using ultrasound (Hanchard et al., 2013). Impingement was felt to have been diagnosed in 27 of 34 cases (79% sensitive, 96% positive predictive value) (Read et al., 1998). A small study of ultrasound the day before surgery for shoulder arthritis in 20 patients suggested that ultrasound was accurate for evaluating hypertrophy of the bursa (93% sensitive, 83% specific), biceps tendon rupture (70% sensitive, 100% specific), and rotator cuff tear (83% sensitive, 57% specific) (Alasaarela et al., 1998). Ultrasound-guided MR arthrography was evaluated in an RCT with anterior versus posterior approaches and found equal ratings of discomfort (Koivikko et al., 2008).

Ultrasound is not invasive, is of low to moderate cost, and has little risk of adverse effects. However, high-quality evidence has consistently documented that US is less effective for the detection of partial-thickness tears (Ardic et al., 2006, Wall et al., 2012, Roberts et al., 2001, Sipola et al., 2010, Naredo et al., 1999). Thus, the indications for US are largely limited to the identification of full-thickness tears by skilled operators. The main disadvantage is the high dependency on the physician's/technician's skills (Boykin et al., 2010, Hanchard et al., 2013).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: ultrasound, sonography, sonographic; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 9675 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 12498 articles, 4297 in Scopus, 277 in CINAHL, 298 in Cochrane Library, 1260 260 in Google Scholar, and 24 from other sources†. We considered for inclusion 1 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 24 from other sources. Of the 27 articles considered for inclusion, 26 diagnostic studies and 1 systematic review met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.13. SINGLE PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

Single-proton emission computed tomography (SPECT) is a 3-dimensional imaging technique that can be used to help diagnose rotator cuff tendinopathies (193) (194) (195).

SPECT FOR SHOULDER DISORDERS

Not Recommended

SPECT is not recommended for the evaluation of patients with shoulder disorders, including rotator cuff tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that SPECT is helpful in improving care of acute, subacute, or chronic shoulder pain compared with MRI, MRA or US. There are no quality studies that PET adds diagnostic benefits for rotator cuff tendinopathies above that achieved by MRI, MRA, US and/or arthroscopy, which are effective to highly effective, and thus SPECT is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Single Photon Emission Computed Tomography, Tomography, Emission-Computed, Single-Photon, Positron Emission Tomography, PET scan; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 27 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 30 articles, 456 in Scopus, 9 in CINAHL, 0 in Cochrane Library, 58 in Google Scholar, and 0 from other sources†. We considered for inclusion 4 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0

from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 1 diagnostic study and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.14. POSITRON EMISSION TOMOGRAPHY (PET)

Positron emission tomography (PET) is a method that can be used to identify issues with the rotator cuff tears in the shoulder (196) (197) (198).

POSITRON EMISSION TOMOGRAPHY FOR DIAGNOSING ROTATOR CUFF TENDINOPATHIES

Not Recommended

PET is not recommended for evaluation of rotator cuff tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies that PET adds diagnostic benefits for rotator cuff tendinopathies above that achieved by MRI, MRA, US and/or arthroscopy, which are effective to highly effective, and thus PET is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Positron Emission Tomography, PET scan; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 23 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 26 articles, 399 in Scopus, 8 in CINAHL, 0 in Cochrane Library, 25 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 2 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.5.15. ARTHROGRAPHY

Arthrography involves the injection of contrast into the joint. It was modified in the 1970s to include injection of air ("double contrast") (131). Arthrography under fluoroscopy in isolation has now been almost entirely replaced by other procedures, including MRI and MRA, primarily due to its low sensitivity for full-thickness tears and essentially no sensitivity for partial thickness tears (199). Most arthrograms including MR arthrogram and CT arthrogram are performed using fluoroscopy to localize the joint and inject the contrast agent.

4.5.16. DIAGNOSTIC INJECTIONS

Diagnostic injections particularly of the subacromial space, glenohumeral joint and acromioclavicular joint are sometimes performed. However, they are nearly always performed in combination with a therapeutic intervention, such as a glucocorticosteroid injection. Injection with a therapeutic agent is nearly always preferable due to less overall invasiveness with 1 injection rather than 2, as well as the potential to assess the patient both immediately post-injection for diagnostic purposes as well as longer term for therapeutic purposes (see Injections).

4.6. TREATMENT RECOMMENDATIONS

4.6.1. INITIAL CARE

Initial care of rotator cuff tendinopathies nearly always involves non-operative treatment during which time it often becomes clearer whether a tear is present, and if so, how significant it is. Still, there should be early consideration as to whether there is a full-thickness complete rotator cuff tear > 1cm in younger patients, which then should result in earlier consideration of surgery as the outcomes in those patients are believed to be better with surgery (see Surgical Considerations).

It is recommended to educate the patient regarding the generally good long-term prognosis, as well as the need to continue use and ROM exercises to prevent potential adhesive capsulitis. For patients with significant pain, over-the-counter (OTC) analgesics (NSAIDs, acetaminophen) and self-applications of heat and ice are recommended. Slings and immobilizers are not recommended, and if used, should be used with daily range of motion exercises and for only a brief course and weaned off use by 3-5 days.

4.6.2. ACTIVITY MODIFICATION AND EXERCISE

Exercises are among the most important therapeutic options for the treatment and rehabilitation of rotator cuff tendinopathies. While there are many ways to categorize and analyze exercise, this guideline evaluates exercise in three broad groupings:

1. range-of-motion exercise,
2. strengthening, and
3. aerobic exercise.

Exercise programs typically include combinations of exercises and are prescribed as self-directed, structured appointments with physical and/or occupational therapists, or often both. Subsequent sections include reviews of spa therapy and balneotherapy.

EXERCISE PRESCRIPTIONS FOR SHOULDER PAIN

Recommended

An exercise prescription is moderately recommended for treatment of acute, subacute, chronic, post-operative shoulder pain. This prescription may either be for self-directed exercises (home program), formal in-clinic, or both.
Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

All patients with shoulder pain, including that due to rotator cuff tendinopathies appear to benefit from an exercise prescription.

Benefits

Improvement in shoulder pain, improved cardiovascular fitness.

Harms

None reported in quality studies. Theoretical risk of myocardial infarction, angina and musculoskeletal injury in a severely deconditioned patient.

Frequency/Dose/Duration

If a supervised program is felt to be needed, recommended frequency is 1 to 3 sessions a week for up to 4 weeks as long as objective functional improvement and symptom reduction is occurring. Results of the exercise prescription should be regularly monitored and failure to progressively improve is an indication to either revisit the differential diagnosis and/or seek a second opinion/consultation, particularly by the time approximately 6-12 therapy appointments is reached.

If self-directed, daily exercise is recommended. An exercise prescription should address specific treatment goals and be time limited with transition to an independent exercise program (no longer considered treatment). The purpose of supervised exercise therapy is symptom reduction, functional improvement, and educating the patient so that he or she can independently manage the program. Evaluation for an exercise prescription involves consideration of four critical components:

- Stage of (theoretical) tissue healing (acute, subacute, chronic),
- Severity of symptoms (mild, moderate, severe),
- Degree and type of deconditioning (flexibility, strength, aerobic, muscular endurance), and
- Psychosocial factors (e.g., medication dependence, fear-avoidance, secondary gain, mood disorders).

Indications for Discontinuation

Recovery, attainment of a functional recovery, complete independence to discharge from a formal program, non-compliance.

Rationale

There are quality studies of the value of exercises; however, there are weaknesses in these studies which limit the strength of the conclusions and the overall evidence base (see specific types of exercise). One trial found a higher dose exercise program superior to a lower dose exercise program, but was susceptible to a contact time bias (Osteras et al., 2010). Another trial found an activity-oriented program was superior (Horst et al., 2017).

Regarding general exercise approach for shoulder pain and rotator cuff tendinopathy, range-of-motion and aerobic exercises are recommended. Strengthening exercises are typically delayed to later in the acute recovery stage or for subacute or chronic shoulder pain. Pain control modalities may be needed as a complement to exercise. The recommended frequency is 1 to 3 sessions a week for up to 4 weeks as long as objective functional improvement and symptom reduction are occurring.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: General Exercise; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 537 articles in PubMed, 4019 in Scopus, 7114 in CINAHL, 42 in Cochrane Library, 2013 in Google Scholar, and 0 from other sources†. We considered for inclusion 10 from PubMed, 0 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 12 articles considered for inclusion, 6 randomized trials and 4 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

AEROBIC EXERCISES FOR TREATMENT OF ROTATOR CUFF TENDINOPATHIES

Recommended

Aerobic exercises are recommended for the treatment of rotator cuff tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

All patients with all stages of shoulder pain. However, those with significant cardiac disease or significant potential for cardiovascular disease should be considered for evaluation prior to instituting vigorous exercises, following the American College of Sports Medicine's *Guidelines for Exercise Testing and Prescription,* 9th ed. (Pescatello, 2014) with regards to health screening and risk stratification.

Benefits

Improved endurance and aerobic capacity. Potential for earlier improvement in range of motion due to use of the arm/arm swing. Improved cardiovascular fitness, improved health status.

Harms

Negligible. None reported in quality studies. Theoretical risk of myocardial infarction and angina in a severely deconditioned patient. Intolerance of weight bearing in severe lower extremity osteoarthrosis. Other musculoskeletal disorders possible (e.g., plantar heel pain).

Frequency/Dose/Duration

There are no quality studies to address intensity. Prior studies for chronic low back pain patients that may be applicable to shoulder pain patients include walking at least 4 times a week at 60% of predicted maximum heart rate (220-age = maximum heart rate) is recommended (Chatzitheodorou D, 2007). Benchmarks were 20 minutes during Week 1, 30 minutes during Week 2, and 45 minutes after that point. Nearly all patients should be encouraged to maintain aerobic exercises on a long-term basis additionally to maintain optimal health.

For post-operative patients, a graded but more reduced walking program is generally desired, often using distance or time as minimum benchmarks – e.g., start with 10 to 50 feet depending largely on severity of the operative procedure. Gradually increasing distance and duration of walking. A reasonable eventual target after the operative recovery period is based on treatment of chronic shoulder pain analogized from low back pain patients as noted above and is walking at least 4 times a week at 60% of predicted maximum heart rate (Chatzitheodorou D, 2007).

Indications for Discontinuation

Transition to a self-directed program is advised for those who have recovered, do not require supervision and/or have been discharged from care. Discontinuation is rarely indicated and may be due to intolerance (rarely occurs), development of other disorders.

Rationale

There are no quality studies addressing the singular utility of aerobic exercises for the treatment of any stage of rotator cuff tendinopathies patients. One moderate-quality RCT with subsequent publications assessed a mixture of types of exercise that included aerobic exercise found a higher dose program to be superior to a lower dose program for subacromial pain patients (Osteras, 2009, Østerås et al., 2008, Osteras et al., 2010).

Yet, many jobs have aerobic demands and thus debility can be harmful and delay return to work. As well, progressive walking involves graded increased use of the shoulder and thus may have some therapeutic value. Progressive aerobic exercises are thus recommended as part of a treatment strategy (typically including range of motion exercises and then strengthening exercises) for the treatment of for the treatment of patients with acute, subacute, chronic and post-operative shoulder pain due to rotator cuff tendinopathies.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Aerobic Exercises; cardiovascular exercises, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 650 articles in PubMed, 4,373 in Scopus, 8 in CINAHL, 1 in Cochrane Library, 6 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 3 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

RANGE-OF-MOTION EXERCISE FOR TREATMENT OF ROTATOR CUFF TENDINOPATHIES

Recommended

Range-of-motion exercises are recommended for the treatment of rotator cuff tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

All patients with shoulder pain, including that due to rotator cuff tendinopathies appear to benefit from an exercise prescription that includes range-of-motion exercises.

Benefits

Improvement in shoulder pain, range of motion and function.

Harms

May have worsened pain while performing the exercises.

Frequency/Dose/Duration

If a supervised program is felt to be needed, recommended frequency is 1 to 3 sessions a week for up to 4 weeks as long as objective functional improvement and symptom reduction is occurring. Results of the exercise prescription should be regularly monitored and failure to progressively improve is an indication to either revisit the differential diagnosis and/or seek a second opinion/consultation, particularly by the time approximately 6-12 therapy appointments is reached.

If self-directed, daily exercise is recommended. An exercise prescription should address specific treatment goals and be time limited with transition to an independent exercise program (no longer

considered treatment). The purpose of supervised exercise therapy is symptom reduction, functional improvement, and educating the patient so that he or she can independently manage the program. Evaluation for an exercise prescription involves consideration of four critical components:

- Stage of (theoretical) tissue healing (acute, subacute, chronic),
- Severity of symptoms (mild, moderate, severe),
- Degree and type of deconditioning (flexibility, strength, aerobic, muscular endurance), and
- Psychosocial factors (e.g., medication dependence, fear-avoidance, secondary gain, mood disorders).

Individualized, supervised programs are generally needed for post-operative care and the length of those prescriptions is typically longer than for non-operative patients. Therapy courses of up to 3 months in more severely affected patients are possible; nevertheless, progressive functional gain should be documented to warrant further batches of appointments. Individualization should be based on factors including age, pre-operative condition, immediate surgical results, contraindications, and other medical conditions; advancement of the program also must be individualized based on progress. Programs and protocols should be closely coordinated with the treating orthopedist, particularly as variability in patients is wide – although workers' compensation patients tend to be younger, in better condition, and able to advance conditioning exercises more rapidly than the elderly. Duration is based primarily on progress. Highly motivated patients may require only weekly sessions for advancement of home exercise program components and may achieve comparable outcomes to a supervised program (Roddey et al., 2002, Andersen et al., 1999). Others require more supervision, particularly if there is significant pain with use.

Indications for Discontinuation

Recovery, attainment of a functional recovery, complete independence to discharge from a formal program, non-compliance.

Rationale

There are six moderate-quality trials involving rotator cuff tendinopathy patients. The highest quality study followed patients for more than 2 years and compared a traditional group (active-assisted ROM on day of surgery, dynamic exercises for rotator cuff after 6 weeks, and strengthening after 8 weeks) versus progressive group (active-assisted ROM and dynamic RC exercises day of surgery, strengthening after 6 weeks) versus home exercise. Many outcome measures favored the progressive exercise group. Two moderate-quality trials suggested that weekly supervised appointments to advance a home-exercise program was equivalent to a traditional rehabilitation program (Roddey et al., 2002, Andersen et al., 1999).

There is one moderate-quality trial suggesting no benefits of continuous passive motion (CPM) post-operatively; however, this study appears underpowered (Raab et al., 1996) and thus there is no recommendation. Another moderate-quality trial suggested this CPM device may have benefits among patients living alone, concerns about adhesions or adhesive capsulitis, repeat rotator cuff repairs, and repair of massive tears (Lastayo et al., 1998).

There are other regimens utilized in quality surgical trials that demonstrate good surgical outcomes, yet there are considerable differences among the reported post-operative rehabilitation studies and trials. These include active-assisted ROM 5 times daily and restoration of rotator cuff muscles and scapular stabilizers after full flexibility is accomplished (Jackins, 2004); submaximal training begun 3 months after surgery (Rahme et al., 1998); active-assisted ROM immediately after surgery; and

eccentric and concentric, isokinetic and manual strengthening at 6 to 12 weeks (Wilk et al., 1993). “No prospective randomized studies have shown rehabilitation with graded exercises to be more effective than other interventions after arthroscopic subacromial decompression. Neither has different progression in workload intensity after this procedure" (Klintberg et al., 2008).

The highest quality surgical trial comparing detailed exercise with arthroscopic decompression for impingement syndrome utilized a regimen of exercise, hot and cold applications, and soft tissue treatments followed by active periscapular muscle training for strengthening the rotator cuff. There were 19 total sessions until discharge to a home-exercise program (Haahr et al., 2005). A second trial was not well described (Brox et al., 1993). Another trial included active and passive shoulder mobilization and stabilizing muscle training (Rubenthaler et al., 2003). Exercise programs are not invasive, have low potential for adverse effects, but generally involve at least moderate to high aggregate costs. They are recommended, although individualization appears necessary and supervised home-exercise programs may suffice for some patients.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Range of Motion Exercises; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 1,276 articles in PubMed, 5,368 in Scopus, 24,860 in CINAHL, 4 in Cochrane Library, 30 in Google Scholar, and 1 from other sources†. We considered for inclusion 1 from PubMed, 4 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 7 articles considered for inclusion, 5 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

STRENGTHENING EXERCISES FOR TREATMENT OF ROTATOR CUFF TENDINOPATHIES

Recommended

Strengthening exercises are recommended for the treatment of rotator cuff tendinopathies.
Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

All patients with shoulder pain, including that due to rotator cuff tendinopathies appear to benefit from an exercise prescription that includes strengthening exercises.

Benefits

Improvement in shoulder pain, strength and function.

Harms

May have worsened pain while performing the exercises.

Frequency/Dose/Duration

If a supervised program is felt to be needed, recommended frequency is 1 to 3 sessions a week for up to 4 weeks as long as objective functional improvement and symptom reduction is occurring. Results of the exercise prescription should be regularly monitored and failure to progressively improve is an indication to either revisit the differential diagnosis and/or seek a second opinion/consultation, particularly by the time approximately 6-12 therapy appointments is reached.

If self-directed, daily exercise is recommended. An exercise prescription should address specific treatment goals and be time limited with transition to an independent exercise program (no longer considered treatment). The purpose of supervised exercise therapy is symptom reduction, functional improvement, and educating the patient so that he or she can independently manage the program. Evaluation for an exercise prescription involves consideration of four critical components:

- Stage of (theoretical) tissue healing (acute, subacute, chronic),
- Severity of symptoms (mild, moderate, severe),
- Degree and type of deconditioning (flexibility, strength, aerobic, muscular endurance), and
- Psychosocial factors (e.g., medication dependence, fear-avoidance, secondary gain, mood disorders).

Indications for Discontinuation

Recovery, attainment of a functional recovery, complete independence to discharge from a formal program, non-compliance.

Rationale

There are multiple moderate-quality RCTs, although they include varying combinations of exercises, and reported evidence of efficacy of strengthening exercises (Holmgren et al., 2012, Maenhout et al., 2013, Mulligan et al., 2016, Turgut et al., 2017). An eccentric exercise program was not found to be superior (Dejaco et al., 2017). One trial suggested minimal differences between open-chain, closed-chain and minimally loaded range of motion exercises (Heron et al., 2017).

Trials of therapy compared with arthroscopic repair for small- to medium-sized rotator cuff tears have suggested surgery is superior as the tears tend to increase in size over time (Moosmayer et al., 2009, Moosmayer et al., 2010, Kukkonen et al., 2015).

Strengthening exercises have quality evidence of efficacy and thought to be important for the treatment and rehabilitation of acute, subacute, chronic and post-operative shoulder conditions especially of the rotator cuff, and thus are recommended. Exercises are also an option for those with small to medium-sized rotator cuff tears who opt for non-operative treatment.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Strengthening Exercises; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 50 articles in PubMed, 282 in Scopus, 46 in CINAHL, 6 in Cochrane Library, 336 in Google Scholar, and 5 from other sources†. We considered for inclusion 10 from PubMed, 3 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 5 from other sources. Of the 20 articles considered for inclusion, 12 randomized trials and 4 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.3. REHABILITATION PROGRAMS

Physical and occupational therapy are professional disciplines. Rehabilitation has been used as part of a treatment plan for the treatment of rotator cuff tendinopathies (200) (201) (202) (82) (203) (204) (205) (206) (207) in the form of a home exercise program delivered in 1 visit or supervised in-clinic program over multiple weeks/months.

PHYSICAL AND/OR OCCUPATIONAL THERAPY FOR TREATMENT OF ROTATOR CUFF TENDINOPATHIES

Recommended

Physical and occupational therapy are recommended for the treatment of rotator cuff tendinopathies, particularly for institution and advancement of quality exercise programs. See separate recommendations for each type of treatment and modality, including exercises, which critically have varying degrees of efficacy and inefficacy.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Generally useful for all phases of treatment for rotator cuff tendinopathy, with the greatest benefits being the need for institution of a quality exercise program, teaching home exercises and graded advancement of the program.

Benefits

Earlier institution of an effective program and advancement of the program of exercise.

Harms

Negligible, unless ineffective treatments are provided, which may then medicalize and prolong the case.

Frequency/Dose/Duration

If a supervised program is felt to be needed, recommended frequency is 1 to 3 sessions a week for up to 4 weeks as long as objective functional improvement and symptom reduction is occurring. Results of the exercise prescription should be regularly monitored and failure to progressively improve is an indication to either revisit the differential diagnosis and/or seek a second opinion/consultation, particularly by the time approximately 6-12 therapy appointments is reached. If self-directed, daily exercise is recommended (see Exercise recommendations).

Indications for Discontinuation

Functional recovery, independence in a home program, or non-compliance.

Rationale

There are quality studies of specific treatments commonly used by physical and/or occupational therapists. Some of these have evidence of efficacy, and some have evidence of a lack of efficacy. There is one trial suggesting no differences between a supervised and an unsupervised program (Granviken et al., 2015). Please see individual treatment and/or modality recommendations.

There are limited studies addressing early vs. late physical therapy, and mostly assessing institution of early compared with late range of motion after arthroscopic repair of rotator cuff tears (Gallagher, 2015, Kluczynski, 2016, Mazzocca et al., 2017). Those studies do not show evidence of benefit of early range of motion. Regardless, studies of early vs. late institution of therapy are challenging to interpret, especially as they are potentially confounded by spectrum bias (earlier resolving cases would naturally be included in the early but not late groups) and thus typically precluding an evidence-based recommendation when there are studies which appear supportive.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Physical Therapy, Physical Therapy Modalities; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 1280 articles in PubMed, 1189 in Scopus, 389 in CINAHL, 426 in Cochrane Library, 1180 in Google Scholar, and 4 from other sources†. We considered for inclusion 1 from PubMed, 4 from Scopus, 4 from CINAHL, 2 from Cochrane Library, 2 from Google Scholar, and 4 from other sources. Of the 17 articles considered for inclusion, 12 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If

relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Early Versus Late Physical Therapy, Early Versus Delayed Physical Therapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 9 articles in PubMed, 3,915 in Scopus, 286 in CINAHL, 0 in Cochrane Library, 451 in Google Scholar, and 1 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 3 articles considered for inclusion, 2 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EXERCISE OR REHABILITATION PROGRAMS FOR POST-OPERATIVE ROTATOR CUFF REPAIR AND/OR SUBACROMIAL DECOMPRESSION

Recommended

A post-operative exercise or rehabilitation program is recommended for post-operative rotator cuff repair.
Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

All post-operative rotator cuff tendinopathy patients are candidates.

Benefits

Improved and earlier return of function

Harms

Negligible

Frequency/Dose/Duration

Programs need to be individualized (see below). Generally, begin with appointments 2 or 3 times weekly and gradually taper as home exercises are instituted and the patient's recovery advances. Courses of up to 3 months in more severe cases may be needed, although most patients require 6 to

8 weeks of supervised programs. Patients should be tracked and show ongoing objective improvements to add additional batches of 6-8 appointments.

Programs need to be individualized based on factors including age, pre-operative condition, immediate surgical results, contraindications, and other medical conditions; advancement of the program also must be individualized based on progress. Programs and protocols should be closely coordinated with the treating orthopedist, particularly as variability in patients is wide – although workers' compensation patients tend to be younger, in better condition, and able to advance conditioning exercises more rapidly than the elderly. Duration is based primarily on progress. Highly motivated patients may require only weekly sessions for advancement of home exercise program components and may achieve comparable outcomes to a supervised program (Roddey et al., 2002, Andersen et al., 1999). Others require more supervision, particularly if there is significant pain with use.

Indications for Discontinuation

Recovery of function, achievement of goals, resolution of pain, patient satisfaction with recovery, lack of ongoing incremental improvement, non-compliance.

Rationale

There are many moderate-quality trials involving patients with rotator cuff tendinopathy. The highest quality study followed patients for more than 2 years and compared a traditional group (active-assisted ROM on day of surgery, dynamic exercises for rotator cuff after 6 weeks, and strengthening after 8 weeks) versus progressive group (active-assisted ROM and dynamic RC exercises day of surgery, strengthening after 6 weeks) versus home exercise. Many outcome measures favored the progressive exercise group. Two moderate-quality trials suggested that weekly supervised appointments to advance a home-exercise program was equivalent to a traditional rehabilitation program (Roddey et al., 2002, Andersen et al., 1999).

There is one moderate-quality trial suggesting no benefits of continuous passive motion (CPM) post-operatively; however, this study appears underpowered (Raab et al., 1996) and thus there is no recommendation. Another moderate-quality trial suggested this CPM device may have benefits among patients living alone, concerns about adhesions or adhesive capsulitis, repeat rotator cuff repairs, and repair of massive tears (Lastayo et al., 1998).

There are other regimens utilized in quality surgical trials that demonstrate good surgical outcomes, yet there are considerable differences among the reported post-operative rehabilitation studies and trials. These include active-assisted ROM 5 times daily and restoration of rotator cuff muscles and scapular stabilizers after full flexibility is accomplished (Jackins, 2004); submaximal training begun 3 months after surgery (Rahme et al., 1998); active-assisted ROM immediately after surgery; and eccentric and concentric, isokinetic and manual strengthening at 6 to 12 weeks (Wilk et al., 1993). "No prospective randomized studies have shown rehabilitation with graded exercises to be more effective than other interventions after arthroscopic subacromial decompression. Neither has different progression in workload intensity after this procedure" (Klintberg et al., 2008).

The highest quality surgical trial comparing detailed exercise with arthroscopic decompression for

impingement syndrome utilized a regimen of exercise, hot and cold applications, and soft tissue treatments followed by active periscapular muscle training for strengthening the rotator cuff. There were 19 total sessions until discharge to a home-exercise program (Haahr et al., 2005). A second trial was not well described (Brox et al., 1993). Another trial included active and passive shoulder mobilization and stabilizing muscle training (Rubenthaler et al., 2003). Exercise programs are not invasive, have low potential for adverse effects, but generally involve at least moderate to high aggregate costs. They are recommended, although individualization appears necessary and supervised home-exercise programs may suffice for some patients.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Post-Operative Exercise or Rehabilitation Program; exercise therapy, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 231 articles in PubMed, 80 in Scopus, 29224 in CINAHL, 56 in Cochrane Library, 239 in Google Scholar, and 12 from other sources†. We considered for inclusion 5 from PubMed, 4 from Scopus, 0 from CINAHL, 4 from Cochrane Library, 0 from Google Scholar, and 12 from other sources. Of the 25 articles considered for inclusion, 17 randomized trials and 8 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MIRROR THERAPY FOR SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for mirror therapy for shoulder pain and rotator cuff tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Indications

None specified.

Rationale

There are no quality trials of mirror therapy for rotator cuff tendinopathies and shoulder pain. A case series has suggested potential efficacy for patients with shoulder pain with reduced range of motion (Louw et al., 2017). There also is evidence of efficacy for strokes and CRPS, and it has been used for adhesive capsulitis. However, in the absence of supportive evidence, there is no recommendation for rotator cuff tendinopathies.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Mirror Therapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 938 in Scopus, 4 in CINAHL, 3 in Cochrane Library, 413 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.4. ALLIED HEALTH INTERVENTIONS

4.6.4.1. BALNEOTHERAPY

Balneotherapy has been used to treat rotator cuff tendinopathies (208) (209) (210) (211) (212) (213) (214).

BALNEOTHERAPY FOR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Balneotherapy is not recommended for treatment of rotator cuff tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no high-quality, sham-controlled studies of balneotherapy for treatment of rotator cuff tendinopathies. Two RCTs compared balneotherapy added to multiple physiotherapy treatments resulting in likely contact time biases and an inability to readily determine benefits of balneotherapy (Tefner et al., 2015, Koç et al., 2021). Another RCT compared with usual care in France and components of care are unclear; as patients had chronic pain, whether the patients already had the usual care is not clear, and is a potentially fatal study flaw (i.e., more of the same bias) (Chary-Valckenaere et al., 2018). Balneotherapy or spa therapy is not invasive, has low adverse effects, is costly, and is without clear evidence of efficacy, and because it relies on a theory of beneficial effects of various salts without clear evidentiary support, is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Balneotherapy, Balneology; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation,

random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 7 articles in PubMed, 315 in Scopus, 0 in CINAHL, 3 in Cochrane Library, 6 in Google Scholar, and 0 from other sources†. We considered for inclusion 2from PubMed, 5 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 7 articles considered for inclusion, 3 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Spa, Spa Therapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 7 articles in PubMed, 347 in Scopus, 0 in CINAHL, 4 in Cochrane Library, 51 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.4.2. MASSAGE

Massage is a commonly used treatment for chronic muscular pain administered by multiple health care providers as well as family or friends. It is most typically used for treatment of spine and torso pain (see Chronic Pain and Low Back Disorders guidelines). It has been utilized for treatment of shoulder disorders, including myofascial pain (see Trigger Points and Myofascial Pain Syndrome). Alternatively, deep friction massage (DFM), a manual treatment intended for tendon disorders, purportedly has some evidence in a foreign language publication for the treatment of tendinopathy. However, there is a lack of supportive English-language publications or isolated evaluation of DFM as a treatment modality (214). Massage has been used to treat rotator cuff tendinopathies (215) (216) (217).

MASSAGE FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against use of massage for rotator cuff tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is one quality trial of massage for shoulder disorders, but it evaluated a long list of diagnoses including arthritis, precluding an assessment of benefits for treatment of specific shoulder pain or rotator cuff tendinopathy patients (van den Dolder et al., 2003). Thus, there is no recommendation for or against use of massage for treatment of shoulder tendinopathies. There are other indications for massage therapy.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: massage; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 37 articles in PubMed, 860 in Scopus, 48 in CINAHL, 38 in Cochrane Library, 239 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 4 articles considered for inclusion, 1 randomized trial and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.4.3. REFLEXOLOGY

Reflexology is a complementary or alternative treatment. It entails the physical act of applying pressure to the feet and hands with specific thumb, finger and hand techniques without the use of oil or lotion. Reflexology is based on a system of zones and reflex areas that reflect an image of the body on the feet and hands with a premise that such work effects a physical change to the body. Reflexology is an alternative medicine practice consisting of applications of pressure to specific points on the hands, feet, and ears (218) (219) (220).

REFLEXOLOGY FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Reflexology is not recommended for treatment of shoulder pain including rotator cuff tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

There are no quality studies of reflexology. It also has not been shown to be efficacious for the treatment of chronic LBP in a moderate-quality study (Poole et al., 2007). Other treatments have been shown to be efficacious and a supportive mechanism for efficacy is inapparent; thus, it is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Reflexology, Zone Therapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 175 articles in PubMed, 25 in Scopus, 24 in CINAHL, 6 in Cochrane Library, 474 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.4.4. ACUPUNCTURE

Acupuncture has been primarily used to treat myofascial (221) and shoulder girdle pain (see Trigger Points/Myofascial Pain). While it has also been used to treat rotator cuff tendinopathies (222) (222) (223) (224) (225), a Cochrane review noted there were few trials of quality with “little can be concluded” (226), while one systematic review recommends acupuncture as a conservative treatment option (227). There are different techniques utilized, including acupuncture, superficial dry needling and deep dry needling (228). Acupuncture is further discussed in the Low Back Disorders and Chronic Pain Guideline. Acupuncture has been used to treat rotator cuff tendinopathies (229) (230) (231) (232) (233) (234).

4.6.4.5. MANIPULATION, MOBILIZATION, AND MANUAL THERAPY

Manual therapy, manipulation, and mobilization to the shoulder girdle and spine have been used to treat shoulder problems, mostly in patients with adhesive capsulitis, some with impingement syndrome (1485) (1486), (1487) (1488) (1489) (1490) (1491) (1492) (1493) and general shoulder pain (985). This has included thoracic spine thrust manipulation utilized for treatment of impingement syndrome (1494) (984) (983). Manual therapy, manipulation, and mobilization have been used to treat rotator cuff tendinopathies by using joint movements, soft tissue massage, and stretches (1495) (1496) (1497) (1498) (1499) (1500) (1501) (1502) (1503) (1504) (1505) (1506) (1507) (1452) (1508)

(1509) (1510) (1511) (1512) (1513) (1514) (1515) (1516) (1517) (1518) (241) (1519) (1520) (1521) (1498) (1522) (1523) (1524) (1525) (1526) (1527) (1528) (1529) (1530) (1531) (1532).

MANIPULATION OF THE THORACIC SPINE FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Manipulation of the thoracic spine is not recommended for rotator cuff tendinopathies.
Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Rationale

Sham-controlled evidence in the higher quality studies consistently suggests that neither thoracic manipulation (Michener LA, 2015, Riley, 2015, Riley, 2015) nor cervical manipulation show evidence of efficacy (Cook, 2014). Thus, manipulation targeting the neck or thoracic spine to treat rotator cuff tendinopathies are not recommended. There are few studies of manipulation targeting the shoulder joint (Winters et al., 1997, Winters et al., 1999, Bergman et al., 2004), and these studies have considerable weaknesses that preclude an evidence-based recommendation. Thus, there is no recommendation for manipulation targeting the shoulder joint.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Manual Therapy, Manipulation, and Mobilization; dynamic humeral centering, mulligan mobilization, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 162 articles in PubMed, 5719 in Scopus, 196 in CINAHL, 267 in Cochrane Library, 1238 in Google Scholar, and 11 from other sources†. We considered for inclusion 28 from PubMed, 3 from Scopus, 8 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 11 from other sources. Of the 51 articles considered for inclusion, 10 randomized trials and 8 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANIPULATION OF THE CERVICAL SPINE FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Manipulation of the cervical spine is not recommended for rotator cuff tendinopathies.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Moderate

Rationale

Sham-controlled evidence in the higher quality studies consistently suggests that neither thoracic manipulation (Michener LA, 2015, Riley, 2015, Riley, 2015) nor cervical manipulation show evidence of efficacy (Cook, 2014). Thus, manipulation targeting the neck or thoracic spine to treat rotator cuff tendinopathies are not recommended. There are few studies of manipulation targeting the shoulder joint (Winters et al., 1999, Winters et al., 1997, Bergman et al., 2004), and these studies have considerable weaknesses that preclude an evidence-based recommendation. Thus, there is no recommendation for manipulation targeting the shoulder joint.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Manual Therapy, Manipulation, and Mobilization; dynamic humeral centering, mulligan mobilization, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 162 articles in PubMed, 5719 in Scopus, 196 in CINAHL, 267 in Cochrane Library, 1238 in Google Scholar, and 11 from other sources†. We considered for inclusion 28 from PubMed, 3 from Scopus, 8 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 11 from other sources. Of the 51 articles considered for inclusion, 36 randomized trials and 8 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANIPULATION OF THE SHOULDER FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against manipulation of the shoulder for treatment of acute, subacute, or chronic rotator cuff tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

Sham-controlled evidence in the higher quality studies consistently suggests that neither thoracic manipulation (Michener LA, 2015, Riley, 2015, Riley, 2015) nor cervical manipulation show evidence of efficacy (Cook, 2014). Thus, manipulation targeting the neck or thoracic spine to treat rotator cuff tendinopathies are not recommended. There are few studies of manipulation targeting the shoulder joint (Winters et al., 1999, Winters et al., 1997, Bergman et al., 2004)[348, 349, 406], and these studies

have considerable weaknesses that preclude an evidence-based recommendation. Thus, there is no recommendation for manipulation targeting the shoulder joint.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Manual Therapy, Manipulation, and Mobilization; dynamic humeral centering, mulligan mobilization, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 162 articles in PubMed, 5719 in Scopus, 196 in CINAHL, 267 in Cochrane Library, 1238 in Google Scholar, and 11 from other sources†. We considered for inclusion 28 from PubMed, 3 from Scopus, 8 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 11 from other sources. Of the 51 articles considered for inclusion, 36 randomized trials and 8 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANUAL THERAPY OR MOBILIZATION OF THE SHOULDER FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against manual therapy or mobilization for treatment of acute, subacute, or chronic rotator cuff tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality sham-controlled trials of mobilization/manual therapy. As there is no evidence of efficacy, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Manual Therapy, Manipulation, and Mobilization; dynamic humeral centering, mulligan mobilization, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 162 articles in PubMed, 5719 in Scopus, 196 in CINAHL, 267 in Cochrane Library, 1238 in Google Scholar, and 10 from other sources†. We considered for inclusion 28 from PubMed, 3

from Scopus, 8 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 10 from other sources. Of the 50 articles considered for inclusion, 35 randomized trials and 8 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANUAL THERAPY OR MOBILIZATION OF THE THORACIC SPINE FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Manual therapy or mobilization of the cervical spine and/or thoracic spine to target rotator cuff tendinopathies are not recommended.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality sham-controlled trials of mobilization/manual therapy. One attempted sham-controlled trial was of only 2 weeks duration and had no subsequent follow-up (Delgado-Gil, 2015). Trials targeting the neck suggest lack of efficacy (Cook, 2014). Multiple trials of mobilization had many co-interventions precluding assessment of efficacy (Satpute, 2015, Teys, 2013). Thus, there is no quality evidence and there is no recommendation for mobilization/manual therapy of the shoulder.

As some evidence suggests inefficacy of neck mobilization for shoulder disorders and there is a lack of plausibility, neck mobilization/manual therapy for rotator cuff tendinopathies is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Manual Therapy, Manipulation, and Mobilization; dynamic humeral centering, mulligan mobilization, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 162 articles in PubMed, 5719 in Scopus, 196 in CINAHL, 267 in Cochrane Library, 1238 in Google Scholar, and 10 from other sources†. We considered for inclusion 28 from PubMed, 3 from Scopus, 8 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 10 from other sources. Of the 50 articles considered for inclusion, 35 randomized trials and 8 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search,

and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANUAL THERAPY OR MOBILIZATION OF THE CERVICAL SPINE FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Manual therapy or mobilization of the cervical spine to target rotator cuff tendinopathies is not recommended.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Moderate

Rationale

There are no quality sham-controlled trials of mobilization/manual therapy. One attempted sham-controlled trial was of only 2 weeks duration and had no subsequent follow-up (Delgado-Gil, 2015). Trials targeting the neck suggest lack of efficacy (Cook, 2014). Multiple trials of mobilization had many co-interventions precluding assessment of efficacy (Satpute, 2015, Teys, 2013). Thus, there is no quality evidence and there is no recommendation for mobilization/manual therapy of the shoulder.

As some evidence suggests inefficacy of neck mobilization for shoulder disorders and there is a lack of plausibility, neck mobilization/manual therapy for rotator cuff tendinopathies is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Manual Therapy, Manipulation, and Mobilization; dynamic humeral centering, mulligan mobilization, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 162 articles in PubMed, 5719 in Scopus, 196 in CINAHL, 267 in Cochrane Library, 1238 in Google Scholar, and 10 from other sources†. We considered for inclusion 28 from PubMed, 3 from Scopus, 8 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 10 from other sources. Of the 50 articles considered for inclusion, 35 randomized trials and 8 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.4.6. CONTINUOUS PASSIVE MOTION

Continuous passive motion (CPM) has been used to treat rotator cuff tendinopathies (235) (236) (237) (238) (239) (240) (241) (242) (243).

CONTINUOUS PASSIVE MOTION FOR ROTATOR CUFF TENDINOPATHY AFTER ROTATOR CUFF REPAIR

Recommended

Continuous passive motion is recommended for the treatment of rotator cuff tendinopathy after rotator cuff repair.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Post-operative rehabilitation, typically for not longer than approximately 2-4 weeks during which time ROM exercises are instituted and advanced.

Benefits

Improved and earlier range of motion, theoretically reduced risk of adhesive capsulitis.

Harms

Reliance on an appliance rather than functional exercise, which may delay recovery

Frequency/Dose/Duration

2 hours/day was used in the one trial suggesting efficacy (Garofalo et al., 2010).

Indications for Discontinuation

Recovery, non-compliance, intolerance

Rationale

One trial found CPM was associated with early benefits in ROM and pain relief, although there were no long term benefits (Garofalo et al., 2010). One trial found CPM was not associated with better outcomes, rather better outcomes were associated with active rehabilitation (Lee et al., 2012). CPM has conflicting and sparse evidence regarding efficacy, is often used to help assure some ROM is performed and thus is recommended; however, institution of active exercises appears beneficial and is recommended to be emphasized.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Continuous Passive Motion; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 115 articles in PubMed, 1462 in Scopus, 14 in CINAHL,

32 in Cochrane Library, 601 in Google Scholar, and 2 from other sources†. We considered for inclusion 5 from PubMed, 0 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 2 from Google Scholar, and 2 from other sources. Of the 10 articles considered for inclusion, 4 randomized trials and 4 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.5. HOT AND COLD THERAPIES

4.6.5.1. CRYOTHERAPY

Cold and heat may have actual therapeutic benefits to modify the disease processes (e.g., cold to allegedly reduce acute inflammation and swelling, and heat to speed healing through increased blood supply) (244) (245). However, others propose that these various modalities are distractants that apparently do not materially alter the clinical course (246). Still others postulate that the distractants allow increased activity levels. Thus, even though distractants might not directly modify the disease processes, this theory supports using these modalities through indirect mechanism(s) of action (247). Many patients with pain report a temporary soothing effect from the application of heat or the use of ice packs in the home setting.

Cryotherapy is used to treat rotator cuff tendinopathies (248) (249) (250) (251) (252) (253) (254). Cold or cryotherapies involve applications of cold or cooling devices to the skin. They have been used for treatment of non-operative pain and post-operative pain (255).

HOME USE OF CRYOTHERAPIES FOR ACUTE, SUBACUTE, CHRONIC, OR PERI-OPERATIVE SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHIES

Recommended

Cryotherapies are recommended for home use for the temporary relief of acute, subacute, chronic, or peri-operative shoulder pain or rotator cuff tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Acute, subacute, chronic, or peri-operative shoulder pain or rotator cuff tendinopathies.

Benefits

Potential modest reduction in shoulder pain. Self-efficacy, although relying on a passive modality.

Harms

Cold injuries. Time may be devoted to passive modality instead of active exercises.

Frequency/Dose/Duration

Applications may be periodic or continuous. Applications should be home-based as there is no evidence for superiority of provider-based heat treatments. Primary emphasis should generally be on functional restoration program elements, rather than on passive treatments in patients with chronic pain. Education regarding home cryotherapy application should be part of the treatment plan if heat has been effective for reducing pain. Self-applications 15-20 minutes, 3-5 times/day is a typical regimen. There are no quality trials to address frequencies.

Indications for Discontinuation

Non-tolerance, including exacerbation of shoulder pain.

Rationale

One comparative trial found equivalent results for either cryotherapy or a therapist-applied shoulder glide (Srivastava et al., 2018). Another comparative trial found no differences between gradual loading of isometric lateral rotation and abduction exercise program and cryotherapy (Dupuis et al., 2018). A low-quality trial found cryotherapy improved pain and range of motion (Parle et al., 2017). There is one moderate-quality trial for post-operative treatment; however, there were no clinical results (Osbahr et al., 2002). Education regarding home cryotherapy application may be part of the treatment if cold is effective in reducing pain. Self applications of cryotherapies using towels or reusable devices are non-invasive, minimal cost, and without complications. Other forms of cryotherapy, including trademarked devices have no evidence of superiority and can be considerably more expensive, including chemicals or cryotherapeutic applications in clinical settings and are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cryotherapy; ice, cold temperature, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 10 articles in PubMed, 264 in Scopus, 28,840 in CINAHL, 15 in Cochrane Library, 2,756 in Google Scholar, and 2 from other sources†. We considered for inclusion 2 from PubMed, 4 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 8 articles considered for inclusion, 6 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.5.2. HEAT THERAPY

Many forms of heat therapy have been used to treat musculoskeletal pain including hot packs, moist hot packs, sauna, warm baths, infrared, diathermy, and ultrasound. The depth of penetration of some

heating agents is minimal since transmission is via conduction or convection, but other modalities have deeper penetration (256). A particular methodological problem with most studies of heat therapy is that despite occasional attempts at, and claims of successful blinding, it is essentially impossible to blind the patient from these interventions as they produce noticeable, perceptible tissue warming. Not surprisingly, some of these heat-related modalities have been shown to reduce pain ratings more than placebo for low back pain patients (see Low Back Disorders). It is less clear whether there are meaningful, long-term benefits. Heat therapies are passive treatments. In chronic pain settings, use of heat should be minimized to self-treatments of flare-ups with primary emphasis on functional restoration elements (e.g., exercises).

HEAT THERAPY FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHIES

Recommended

Self-application of low-tech heat therapy is recommended for acute, subacute, chronic or post-operative shoulder pain.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Acute, subacute, chronic, or post-operative shoulder pain or rotator cuff tendinopathies.

Benefits

Potential modest reduction in shoulder pain. Self-efficacy, although relying on a passive modality.

Harms

Heat injuries. Time may be devoted to passive modality instead of active exercises.

Frequency/Dose/Duration

Applications may be periodic or continuous. Applications should be home-based as there is no evidence for superiority of provider-based heat treatments. Primary emphasis should generally be on functional restoration program elements, rather than on passive treatments in patients with chronic pain. Education regarding home heat application should be part of the treatment plan if heat has been effective for reducing pain. Self-applications 15-20 minutes, 3-5 times/day is a typical regimen. There are no quality trials to address frequencies.

Indications for Discontinuation

Intolerance, increased pain, development of a burn, other adverse event.

Rationale

There is no quality evidence using typical self-applied forms of heat therapy. Self applications of heat using towels or reusable devices are non-invasive, minimal cost and without complications. Heat is not commonly used in acute situations (first few days); however, evidence suggests heat is effective for acute LBP (see Low Back Disorders). Thus, efficacy for acute pain is unclear. Other forms of heat can be considerably more expensive, including chemical applications in clinical settings and are not

recommended. There is one moderate quality study suggesting hyperthermia is superior to ultrasound for patients with supraspinatus tendinopathies in athletes, although that did not involve self-application of heat (Giombini et al., 2006).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: heat therapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 84 articles in PubMed, 433 in Scopus, 22 in CINAHL, 4 in Cochrane Library, 546 in Google Scholar, and 2 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 2 article considered for inclusion, 2 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.5.3. DIATHERMY AND INFRARED THERAPY

There are many commercial modalities used to deliver heat; these generally differ on how deeply the heat is felt. None of these modalities other than ultrasound have demonstrated major efficacy for any disorder, however, there have been limited uses for treatment of specific disorder with a specific intervention (see Hand, Wrist, and Forearm Disorders, Elbow Disorders, Low Back Disorders, and Chronic Pain Guideline). Diathermy and infrared therapy have been used to treat rotator cuff tendinopathies (257) (258) (259) (260) (261).

DIATHERMY FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of diathermy for the treatment of acute, subacute, or chronic shoulder pain or rotator cuff tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One RCT found a lack of efficacy of microwave diathermy compared with placebo (Akyol et al., 2012). Another RCT suggested efficacy of short-wave diathermy (Yilmaz Kaysin et al., 2018). While they are not invasive and have low complication rates, diathermy and infrared therapy are moderate to high cost depending on the number of treatments. With conflicting evidence of efficacy, there is no recommendation for or against their use to treat shoulder pain.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Diathermy and Infrared Therapy; hyperthermia, heat, microwave, tecar therapy, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 158 articles in PubMed, 607 in Scopus, 29 in CINAHL, 41 in Cochrane Library, 60 in Google Scholar, and 1 from other sources†. We considered for inclusion 3 from PubMed, 1 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 6 articles considered for inclusion, 4 randomized trials and 1 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INFRARED THERAPY FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of infrared therapy for the treatment of acute, subacute, or chronic shoulder pain or rotator cuff tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One RCT found a lack of efficacy of microwave diathermy compared with placebo (Akyol et al., 2012). Another RCT suggested efficacy of short-wave diathermy (Yilmaz Kaysin et al., 2018). While they are not invasive and have low complication rates, diathermy and infrared therapy are moderate to high cost depending on the number of treatments. With conflicting evidence of efficacy, there is no recommendation for or against their use to treat shoulder pain.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Diathermy and Infrared Therapy; hyperthermia, heat, microwave, tecar therapy, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 158 articles in PubMed, 607 in Scopus, 29 in CINAHL, 41 in Cochrane Library, 60 in Google Scholar, and 1 from other sources†. We considered for inclusion 3 from PubMed, 1 from Scopus, 0 from CINAHL, 1 from

Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 6 articles considered for inclusion, 4 randomized trials and 1 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.5.4. ULTRASOUND

Ultrasound has been used for treatment of rotator cuff tendinitis and calcific tendinitis (262) (263) (264) (265) (266) (267) (268) (269) (270) (271) (272) (273) (274) (275) (276) (277) (278) (279) (280) (281). Ultrasound has also been used to guide needling (see separate recommendation on ultrasound-guided needling).

ULTRASOUND FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Ultrasound is not recommended for the treatment of acute, subacute, or chronic shoulder pain or rotator cuff tendinopathies.
Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Rationale

The largest, highest quality blinded sham-controlled study of shoulder soft tissue disorders found a lack of efficacy of ultrasound vs. sham (van der Heijden et al., 1997). Most of the other trials found no benefits compared to sham or other active treatments (Johansson et al., 2005). One moderate-quality trial found efficacy for treatment of patients with calcific tendinitis (Ebenbichler et al., 1999). Another moderate-quality trial with a much smaller sample size that combined ultrasound with acetic acid iontophoresis found a lack of efficacy (Perron et al., 1997). Ultrasound is not invasive, has low adverse effects, but is moderate to high cost depending on the number of treatments. It is recommended for treatment of calcific tendinitis as the highest quality, largest sample sized-study documents efficacy. However, it is not recommended for shoulder pain to include tendinopathies other than calcific tendinitis, as there is not clear documentation of efficacy for other than patients with calcific tendinitis. As there is no evidence for efficacy of ultrasound for non-calcific tendinitis shoulder pain, home units are also not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasound; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 423 articles in PubMed, 4207 in Scopus, 143 in CINAHL, 88 in

Cochrane Library, 1200 in Google Scholar, and 7 from other sources†. We considered for inclusion 4 from PubMed, 4 from Scopus, 2 from CINAHL, 2 from Cochrane Library, 1 from Google Scholar, and 7 from other sources. Of the 20 articles considered for inclusion, 7 randomized trials and 6 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ULTRASOUND FOR CALCIFIC TENDINITIS

Recommended

Ultrasound is recommended for the treatment of calcific tendinitis.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Symptomatic calcific rotator cuff tendinitis.

Benefits

Improved pain control

Harms

Negligible

Frequency/Dose/Duration

Ultrasound (0.89MHz, 2.5W/cm2) up to 24, 15-minute sessions, daily for 5 weeks, then 3 a week for 3 weeks (Ebenbichler et al., 1999).

Indications for Discontinuation

Intolerance, adverse effect or resolution of pain.

Rationale

One moderate-quality trial found efficacy for treatment of patients with calcific tendinitis (Ebenbichler et al., 1999), although a 10-year outcomes study found comparable rates of resolution of the calcium deposits (Pieber, 2018). Another RCT also suggested efficacy (Shomoto, 2002). Ultrasound is not invasive, has low adverse effects, but is moderate to high cost depending on the number of treatments. It is recommended for treatment of calcific tendinitis as the highest quality, largest sample sized-study documents efficacy. As there is evidence of efficacy, but not for home units, there is no recommendation for or against use of home ultrasound units.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: ultrasound, ultrasonography; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 423 articles in PubMed, 4207 in Scopus, 143 in CINAHL, 88 in Cochrane Library, 1200 in Google Scholar, and 7 from other sources†. We considered for inclusion 4 from PubMed, 4 from Scopus, 2 from CINAHL, 2 from Cochrane Library, 1 from Google Scholar, and 7 from other sources. Of the 20 articles considered for inclusion, 3 randomized trials and 6 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.5.5. LOW-LEVEL LASER THERAPY

Low-level laser treatment (LLLT) usually involves laser energy that does not induce significant heating. It is theorized that the mechanism of action is through photoactivation of the oxidative chain and has been used for treatment of rotator cuff tendinopathies (264) (282) (283) (284) (285) (286) (287) (288) (289) (290) (291) (292) (293) (294) (295) (296) (297).

LOW-LEVEL LASER THERAPY FOR ACUTE, SUBACUTE OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Low-level laser therapy is not recommended for treatment of rotator cuff tendinopathies.
Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Rationale

There are six sham-controlled trials, nearly all assessing additive benefit to exercise programs (England et al., 1989, Vecchio et al., 1993, Dogan et al., 2010, Abrisham et al., 2011, Bingol et al., 2005, Yeldan et al., 2009). Four of the six found no benefits of the laser (Vecchio et al., 1993, Dogan et al., 2010, Bingol et al., 2005, Yeldan et al., 2009). One of the two studies suggesting benefits only followed patients for two weeks (Abrisham et al., 2011), and was therefore insufficient for producing a guideline recommendation on efficacy for chronic pain conditions. One trial suggested comparable (in)efficacy between LLLT and US (Yavuz et al., 2014). Thus, the literature largely suggests LLLT is ineffective for shoulder pain. LLLT is not invasive, has few adverse effects, but is costly. As most data suggest a lack of efficacy, LLLT is not recommended for treatment of rotator cuff tendinopathies.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Low-level laser Therapy, laser therapies; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 39 articles in PubMed, 610 in Scopus, 26 in CINAHL, 14 in Cochrane Library, 118 in Google Scholar, and 8 from other sources†. We considered for inclusion 4 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 8 from other sources. Of the 13 articles considered for inclusion, 11 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.6. MEDICATIONS

4.6.6.1. NSAIDS AND ACETAMINOPHEN

Nonsteroidal anti-inflammatory drugs (NSAIDs) have been widely used to treat shoulder pain, including tendinoses (298) (203) (299), as well as post-operative patients. Acetaminophen and paracetamol are sometimes utilized to treat shoulder pain, although their effects on cyclooxygenase activity are minimal, they are not considered to have significant anti-inflammatory properties and the overall evidence suggests NSAIDs have superior efficacy. Nonsteroidal anti-inflammatory drugs are used to treat pain, fever, and inflammation (300) (301) (302) (303) (304) (305) (306) (307) (308) (309) (310) (311) (312) (313) (314) (315) (316) (317) (318) (319) (320) (321).

NSAIDS FOR TREATMENT OF ROTATOR CUFF TENDINOPATHIES AND SHOULDER PAIN

Recommended

NSAIDs are recommended for treatment of acute, subacute, and chronic shoulder pain, including rotator cuff tendinopathies. Acetaminophen is a reasonable alternative, although evidence indicates it is modestly less efficacious.

Generally, generic ibuprofen, naproxen or other older generation NSAIDs are recommended as first-line medications. Second-line medications should generally include one of the other generic NSAIDs. Options for those at increased risk of gastrointestinal complications (especially a history of gastrointestinal bleeding or prior history of peptic ulcer disease) include COX-2 selective agents, proton pump inhibitors, high-dose misoprostol, and sucralfate.
Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

Indications

For acute, subacute, or chronic shoulder pain including rotator cuff tendinopathies, NSAIDs are recommended for treatment (Berry et al., 1980, Adebajo et al., 1990, Petri et al., 1987, Mena et al., 1986). Over-the-counter (OTC) agents may suffice and may be tried first.

Benefits

Modest reduction in shoulder pain and earlier recovery. Pain improvements without impairments other medications cause.

Harms

Generally negligible in young healthy patients. Gastrointestinal bleeding, other bleeding, and possible delayed fracture healing. Possible elevated cardiovascular risks including myocardial infarction, especially for high-dose COX-2 inhibitors and NSAIDS that have a moderate-degree of COX inhibition such as with diclofenac. Renal failure may occur particularly in the elderly or those with otherwise compromised function.

Frequency/Dose/Duration

See manufacturer's recommendations. Generally, in acute shoulder pain patients, scheduled dosage rather than as needed is preferable. As needed prescriptions may be reasonable for mild or moderate pain, while scheduled usage, rather than as-needed, for treatment of more severe pain especially if there is consideration for adjunctive treatment with muscle relaxants, opioids, or other potentially impairing medications. Once the patient moves to a supportive long-term care plan for chronic shoulder pain, the patient may revert to selective use for "flare ups," with some patients also using NSAIDs to maintain work status and function.

Indications for Discontinuation

Resolution of shoulder pain, lack of efficacy, or development of adverse effects that necessitate discontinuation.

Rationale

The literature base for the treatment of musculoskeletal disorders (MSDs) is long and deep (mostly low back pain and arthroses). Thus, most literature on the use of NSAIDs to treat shoulder disorders consists of comparable efficacy studies and some studies also include mixtures of patient diagnoses. Still, there are a few high- and moderate-quality RCTs including a placebo arm, all of which show efficacy of NSAIDs compared with placebo for treatment of rotator cuff tendinitis, shoulder pain and shoulder bursitis (Petri et al., 2004, Adebajo et al., 1990, Mena et al., 1986).

Nearly all of the comparable efficacy literature for NSAIDs reported equivalency (Bertin et al., 2003, Vidal et al., 2001, Smith et al., 1986). One high-quality study found equivalency between celecoxib and naproxen for the treatment of acute shoulder tendinitis or bursitis patients (Bertin et al., 2003). Another high-quality study found equivalency between piroxicam and meloxicam for treatment of acute rotator cuff tendinitis, impingement syndrome and bicipital tendinitis (Vidal et al., 2001). Multiple moderate-quality studies found equivalency between various NSAIDs for treatment of diagnoses that included shoulder tendinitis or bursitis (Petri et al., 2004, Petri et al., 1987, Smith et al., 1986, Lecomte et al., 1994, Hayes et al., 1984, Wober, 1999, Huskisson et al., 1983, Duke et al., 1981,

Rhind et al., 1982). One trial found equivalence for piroxicam and naproxen for the treatment of chronic shoulder pain (Smith et al., 1986). There is one trial that is the exception, reporting piroxicam superior to naproxen (McIlwain et al., 1988).

One RCT found higher retear rates among celecoxib treated patients compared with ibuprofen or tramadol (Oh et al., 2018), and speculated this may be due to a Cox-2 inhibitory effect. Multiple RCTs found superiority of glucocorticosteroid injection to NSAID (Adebajo et al., 1990, Petri et al., 1987), while one found equivalence (White et al., 1986).

There are several classes of NSAIDs: 1) salicylates [aspirin, diflunisal, salicyl salicylate (salsalate)], 2) arylalkanoic acids (diclofenac, etodolac, ketorolac, nabumetone, sulindac, tolmetin), 3) 2-arylpropionic acids (ibuprofen, fenoprofen, ketoprofen, naproxen), 4) n-arylanthranilic acids (mefenamic acid), 5) oxicams (piroxicam, meloxicam), 6) COX-2 inhibitors (celecoxib, rofecoxib, etoricoxib), and 7) sulphonanilides (nimesulide). Acetaminophen is considered an analgesic that is not an anti-inflammatory agent. Acetaminophen blocks the activation of COX by another enzyme, peroxidase. Tissues with high levels of peroxidase (i.e., platelets and immune cells) are “resistant” to acetaminophen, but tissues with low levels of peroxidase (i.e., nerve and endothelial cells that participate in pain and fever) are “sensitive” to acetaminophen (Boutaud et al., 2002).

There are two isoenzymes of cyclooxygenase, COX-1 and COX-2. NSAIDs are (non) selective to different degrees. COX-2 selective agents were designed to reduce inflammation while not increasing risks for gastrointestinal bleeding. It appears that certain COX-2 selective agents may increase the risk of cardiovascular events.

There is a dearth of trials comparing the various NSAIDs, and the doses used are at times submaximal in some of the comparative arms of the trials, raising problems with direct comparability to help guide specific NSAID selection.
Cardiovascular risks of NSAIDs are somewhat controversial (Antman et al., 2007). Most studies have suggested elevated risks with high-dose rofecoxib, few have shown elevated risks with ibuprofen or naproxen, and there is some evidence for increasing risks with greater degrees of COX-2 inhibition (McGettigan et al., 2011, McGettigan et al., 2006, Bombardier et al., 2000, Fosbol et al., 2010, Fosbol et al., 2010, Nussmeier et al., 2005, Ott et al., 2003, Trelle et al., 2011). The sequence of NSAIDs from lowest COX-2 to highest varies somewhat between studies but is reportedly: flurbiprofen, ketoprofen, fenoprofen, tolmetin, aspirin, oxaprozin, naproxen, indomethacin, ibuprofen, ketorolac, piroxicam, nabumetone, etodolac, celecoxib, meloxicam, mefenamic acid, diclofenac, rofecoxib and nimesulide (Feldman et al., 2000).

There are few quality studies of acetaminophen as a single agent, and none exclusively for shoulder pain. Most of the literature has been developed for treatment of low back pain (see Low Back Disorders Guideline) (Chou et al., 2007, Dahners et al., 2004, Jirarattanaphochai et al., 2008, Krismer et al., 2007, Kroenke et al., 2009, Kuijpers et al., 2011, Last et al., 2009, Machado et al., 2009, Machado et al., 2015) or osteoarthrosis (see Knee Disorders Guideline). Paracetamol, a close analog, has also been studied for LBP and osteoarthrosis and has some evidence of mild efficacy in most trials (Davies et al., 2008), although a review concluded it lacks efficacy (Machado et al., 2015). The direct evidence of efficacy from the two available studies suggests paracetamol is not quite as successful at alleviating pain as diflunisal (Hickey, 1982), mefenamic acid (Evans et al., 1980), indomethacin (Evans et al., 1980),

or aspirin (Evans et al., 1980). It also has relieved pain less successfully than the muscle relaxants orphenadrine (McGuinness, 1983) and parazolidin (McGuinness et al., 1969). It is interesting that paracetamol appears more effective in combination with orphenadrine than as a single agent (Valtonen, 1975). Thus, while the evidence suggests efficacy of acetaminophen and paracetamol, it appears these medications are modestly less efficacious than NSAIDs (although safer).

NSAIDs are not invasive, have low side effect profiles in a healthy working-age patient population, and when generic medications are used are low cost. The potential for NSAIDs to increase the risk of cardiovascular events needs to be carefully considered in high-risk patients and requires additional quality studies to fully address. There is substantial, quality evidence that COX-2 selective NSAIDs reduce the risk of adverse GI effects (Baraf et al., 2007, Bensen et al., 2000, Chan, 2005, FitzGerald et al., 2001, Bombardier et al., 2000). Additionally, the four commonly used cytoprotective classes of drugs are proton pump inhibitors, misoprostol, sucralfate, and double-dose histamine-type 2 receptor blockers (see Hip and Groin Disorders Guideline for details).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Nonsteroidal anti-inflammatory drugs (NSAID) ; COX-2 inhibitors, ketorolac, ibuprofen, dexketoprofen, celecoxib, parecoxib, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 185 articles in PubMed, 599 in Scopus, 31 in CINAHL, 42 in Cochrane Library, 46 in Google Scholar, and 23 from other sources†. We considered for inclusion 8 from PubMed, 7 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 2 from Google Scholar, and 23 from other sources. Of the 41 articles considered for inclusion, 33 randomized trials and 8 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

NSAIDS FOR TREATMENT OF PERIOPERATIVE OR POSTOPERATIVE SHOULDER PAIN

Recommended

NSAIDs are recommended for treatment of perioperative and postoperative shoulder pain, including rotator cuff tendinopathies. Acetaminophen is a reasonable alternative, although evidence indicates it is modestly less efficacious.

Generally, generic ibuprofen, naproxen or other older generation NSAIDs are recommended as first-line medications. Second-line medications should generally include one of the other generic NSAIDs. Options for those at increased risk of gastrointestinal complications (especially a history of

gastrointestinal bleeding or prior history of peptic ulcer disease) include COX-2 selective agents, proton pump inhibitors, high-dose misoprostol, and sucralfate.
Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

For perioperative and postoperative shoulder pain including rotator cuff tendinopathies, NSAIDs are recommended for treatment (Berry et al., 1980, Adebajo et al., 1990, Petri et al., 1987, Mena et al., 1986). Over-the-counter (OTC) agents may suffice and may be tried first.

Benefits

Modest reduction in shoulder pain and earlier recovery. Pain improvements without impairments other medications cause.

Harms

Generally negligible in young healthy patients. Gastrointestinal bleeding, other bleeding, and possible delayed fracture healing. Possible elevated cardiovascular risks including myocardial infarction, especially for high-dose COX-2 inhibitors and NSAIDS that have a moderate-degree of COX inhibition such as with diclofenac. Renal failure may occur particularly in the elderly or those with otherwise compromised function.

Frequency/Dose/Duration

See manufacturer's recommendations. Generally, in acute shoulder pain patients, scheduled dosage rather than as needed is preferable. As needed prescriptions may be reasonable for mild or moderate pain, while scheduled usage, rather than as-needed, for treatment of more severe postoperative pain especially if there is consideration for adjunctive treatment with muscle relaxants, opioids, or other potentially impairing medications. Generally, treat post-operative patients for 2 to 8 weeks post-op unless complications occur.

Indications for Discontinuation

Resolution of shoulder pain, lack of efficacy, or development of adverse effects that necessitate discontinuation.

Rationale

The literature base for the treatment of musculoskeletal disorders (MSDs) is long and deep (mostly low back pain and arthroses). Thus, most literature on the use of NSAIDs to treat shoulder disorders consists of comparable efficacy studies and some studies also include mixtures of patient diagnoses. Still, there are a few high- and moderate-quality RCTs including a placebo arm, all of which show efficacy of NSAIDs compared with placebo for treatment of rotator cuff tendinitis, shoulder pain, and shoulder bursitis (Petri et al., 2004, Adebajo et al., 1990, Mena et al., 1986).

There are few trials of NSAIDS specifically for peri- and post-operative shoulder pain. Regarding post-operative studies, one trial found ketoprofen superior to placebo (Hoe-Hansen et al., 1999).

There is a dearth of trials comparing the various NSAIDs, and the doses used are at times submaximal in some of the comparative arms of the trials, raising problems with direct comparability to help guide specific NSAID selection.

NSAIDs are not invasive, have low side effect profiles in a healthy working-age patient population, and when generic medications are used are low cost. The potential for NSAIDs to increase the risk of cardiovascular events needs to be carefully considered in high-risk patients and requires additional quality studies to fully address.

NSAIDS FOR PATIENTS AT RISK FOR CARDIOVASCULAR ADVERSE EFFECTS

Recommended

Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed. Some NSAIDs appear to have substantially different levels of cardiovascular risk. Aspirin is likely the lowest risk, is cardioprotective, and available OTC, although it causes increased risk of GI bleeding.

See Hip and Groin Disorders guideline for details.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

PROTON PUMP INHIBITORS WITH NSAIDS FOR PATIENTS AT RISK FOR GI ADVERSE EFFECTS

Recommended

Concomitant prescriptions of cytoprotective medications are recommended for patients at substantially increased risk for gastrointestinal bleeding.

See Hip and Groin Disorders guideline for details.
Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

MISOPROSTOL WITH NSAIDS FOR PATIENTS AT RISK FOR GI ADVERSE EFFECTS

Recommended

Concomitant prescriptions of cytoprotective medications are recommended for patients at substantially increased risk for gastrointestinal bleeding.
Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

SUCRALFATE WITH NSAIDS FOR PATIENTS AT RISK FOR GI ADVERSE EFFECTS

Recommended

Concomitant prescriptions of cytoprotective medications are recommended for patients at substantially increased risk for gastrointestinal bleeding.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

H2 BLOCKERS WITH NSAIDS FOR PATIENTS AT RISK FOR GI ADVERSE EFFECTS

Recommended

Concomitant prescriptions of cytoprotective medications are recommended for patients at substantially increased risk for gastrointestinal bleeding.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

ACETAMINOPHEN FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN

Recommended

Acetaminophen is recommended for acute, subacute, or chronic shoulder pain, particularly for those with contraindications for NSAIDs.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Shoulder pain, including acute, subacute, or chronic. Generally used as supplemental to other treatments and particularly among those with reasons to avoid NSAIDs.

Benefits

Addresses shoulder pain without increased risk of cardiovascular event.

Harms

Less effective than NSAID. Hepatotoxicity, especially beyond 3.5g/day and/or with other liver disease(s).

Frequency/Dose/Duration

See manufacturer's recommendations; may be utilized on an as-needed basis. It has been suggested that 1gm doses are more effective than 650mg doses particularly in post-operative patients (listed, 2009, McQuay et al., 2002). However, this level is now above the maximum dose recommended by an FDA advisory committee of 650mg. Evidence of hepatic toxicity has been reported at 4gms a day in a few days particularly among those consuming excessive alcohol.

Indications for Discontinuation

Resolution of pain, adverse effects, intolerance.

Rationale

There are no quality trials of acetaminophen for treatment of non-surgical shoulder tendinitis or shoulder disorders. A low quality RCT found acetaminophen was inferior to ibuprofen for rotator cuff related pain and had more dropouts the acetaminophen group (AlRuthia et al., 2019).

Acetaminophen is considered an analgesic that is not anti-inflammatory. Acetaminophen blocks the activation of COX by another enzyme, peroxidase. Tissues with high levels of peroxidase (i.e., platelets

and immune cells) are “resistant” to acetaminophen, but tissues with low levels of peroxidase (i.e., nerve and endothelial cells that participate in pain and fever) are “sensitive” to acetaminophen (Boutaud et al., 2002). The direct evidence of efficacy from the two available studies suggests paracetamol is not quite as successful at alleviating LBP as diflunisal (Hickey, 1982), mefenamic acid (Evans et al., 1980), indomethacin (Evans et al., 1980), or aspirin (Evans et al., 1980). There is one trial suggesting it is more efficacious than physiotherapy and manipulation (Doran et al., 1975), and worse than electroacupuncture (Hackett et al., 1988). Acetaminophen was worse than chlorzoxazone (Vernon, 1972) and was inferior to diflunisal even when combined with codeine (Brown et al., 1986).

There are quality trials of other MSDs, which document efficacy for acetaminophen, but inferiority to NSAIDs for treatment of pain (see Low Back Disorders guideline). Thus, by analogy, there is evidence of efficacy for acetaminophen, it has low adverse effects in employed populations, and it is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Acetaminophen, paracetamol; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 38 articles in PubMed, 1810 in Scopus, 20 in CINAHL, 20 in Cochrane Library, 148 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 4 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 2 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ACETAMINOPHEN FOR PERIOPERATIVE OR POSTOPERATIVE SHOULDER PAIN

Recommended

Acetaminophen is recommended for post-operative shoulder pain, particularly for those with contraindications for NSAIDs.
Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

Postoperative shoulder pain. Generally used as supplemental to other treatments and particularly among those with reasons to avoid NSAIDs.

Benefits

Addresses shoulder pain without increased risk of cardiovascular event.

Harms

Less effective than NSAID. Hepatotoxicity, especially beyond 3.5g/day and/or with other liver disease(s).

Frequency/Dose/Duration

See manufacturer's recommendations; may be utilized on an as-needed basis. It has been suggested that 1gm doses are more effective than 650mg doses particularly in post-operative patients (listed, 2009, McQuay et al., 2002). However, this level is now above the maximum dose recommended by an FDA advisory committee of 650mg. Evidence of hepatic toxicity has been reported at 4gms a day in a few days particularly among those consuming excessive alcohol.

Indications for Discontinuation

Resolution of pain, adverse effects, intolerance.

Rationale

There are no quality trials of acetaminophen for treatment of non-surgical shoulder tendinitis or shoulder disorders. A low quality RCT found acetaminophen was inferior to ibuprofen for rotator cuff related pain and had more dropouts the acetaminophen group (AlRuthia et al., 2019).

Regarding post-operative use, one moderate quality RCT found acetaminophen 1g every 6 hours the day before shoulder surgery and 1g every 8 hours for days 2-5 postoperatively to be superior pain control compared with (i) oxycodone 5mg every 6 hours as needed and/or acetaminophen 1g every 6 hours as needed and (ii) oxycodone 5mg every 6 hours as needed without any acetaminophen (Singh et al., 2021).

There are quality trials of other MSDs, which document efficacy for acetaminophen, but inferiority to NSAIDs for treatment of pain (see the Low Back Disorders guideline). Thus, by analogy, there is evidence of efficacy for acetaminophen, it has low adverse effects in employed populations, and it is recommended.

4.6.6.2. ANTIDEPRESSANTS

NOREPINEPHRINE REUPTAKE INHIBITING ANTI-DEPRESSANTS FOR SUBACUTE OR CHRONIC SHOULDER GIRDLE PAIN, INCLUDING MYOFASCIAL PAIN SYNDROME AND SELECT CASES OF ROTATOR CUFF TENDINOPATHY

Recommended

Norepinephrine reuptake inhibiting anti-depressants (including tricyclic antidepressants and SNRIs) are recommended for subacute or chronic shoulder pain and myofascial pain syndrome (see Chronic Pain Guideline), and a reasonable option for select rotator cuff tendinopathy patients.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Subacute and chronic shoulder pain and myofascial pain; may be particularly helpful if there is nocturnal sleep disruption, mild dysthymia, which may allow for nocturnal dosing of a mildly sedating TCA. May be helpful for select rotator cuff tendinopathy patients especially with moderate to severe pain that is ongoing, and/or sleep disrupting.

Benefits

Improvements in shoulder pain. May improve sleep quality.

Harms

Daytime somnolence, interference with work, dry mouth, cardiac risks, and other adverse effects.

Frequency/Dose/Duration

Low dose at night, gradually increased (e.g., amitriptyline 25mg QHS, increase by 25mg each week) until a sub-maximal or maximal dose achieved, sufficient effects are achieved, or adverse effects occur. Lower doses (e.g., amitriptyline, 25 to 75mg a day) avoid adverse effects and the necessity of blood level monitoring, particularly as there is no evidence of increased pain relief at higher doses. Imipramine is less sedating, thus if carryover daytime sedation, it may be a better option. If patient cannot sleep, amitriptyline is the recommended initial medication in this class. Duration for patients with subacute and chronic shoulder pain may be indefinite, although most of these patients do not require indefinite treatment, particularly if they are compliant with elements of a functional restoration program.

Indications for Discontinuation

Resolution of pain, intolerance, development of adverse effects.

Rationale

There are no quality studies evaluating these agents for rotator cuff tendinopathies. However, there are multiple placebo-controlled trials evaluating efficacy of anti-depressants for treatment of low back pain, with nearly all studies evaluating chronic pain (see Low Back Disorders Guideline). Some included patients with depression while some specifically sought to exclude those with depression. Effects appear to differ by class of agent, with norepinephrine reuptake inhibition appearing important.

Norepinephrine reuptake inhibitor anti-depressants are not invasive, have low to moderate dose-dependent adverse effects at low doses, and are not costly in their generic formulations. The degree to which depression or dysthymia is present may suggest earlier use of these medications. Discussions with mental health professionals may be helpful, particularly when mental health conditions are more severe. Norepinephrine reuptake inhibiting anti-depressants are recommended for treatment of chronic shoulder pain, and selectively recommended for those in whom NSAIDs are either ineffective or not indicated, yet have need of a non-addicting medication to potentially assist with sleep in the acute to subacute phases.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Norepinephrine Reuptake Inhibitors; serotonin and noradrenaline reuptake inhibitors, tricyclic antidepressants rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 180 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 26 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SELECTIVE SEROTONIN REUPTAKE INHIBITORS FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHIES

Not Recommended

Selective serotonin reuptake inhibitors (SSRIs) are not recommended for treatment of acute, subacute, or chronic shoulder pain or rotator cuff tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

Norepinephrine reuptake inhibiting anti-depressants (e.g., amitriptyline, doxepin, imipramine, desipramine, nortriptyline, protriptyline, maprotiline, and clomipramine) and mixed norepinephrine and serotonin inhibitors (venlafaxine, bupropion, and duloxetine) have evidence of efficacy for treatment of chronic low back pain and some other chronic pain conditions (see Low Back Disorders). However, SSRIs have evidence of efficacy for fibromyalgia (see guideline), but quality evidence shows SSRIs are ineffective for typical nociceptive pain (see Low Back Disorders and Chronic Pain Guideline). While there is no quality evidence evaluating these medications for treatment of shoulder pain, SSRIs appear unlikely to be effective for typical nociceptive pain such as rotator cuff tendinopathies and thus are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Selective Serotonin Reuptake Inhibitor; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 304 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 61 in Google Scholar, and 0 from other sources†. We considered for

inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.6.3. ANTICONVULSANTS

Anticonvulsant agents have been utilized off-label for treating some chronic pain syndromes since the 1960s (322), particularly neuropathic pain (323). Anti-convulsants are thought to have analgesic properties. Several have been used to manage chronic pain conditions including carbamazepine, valproic acid, gabapentin, phenytoin, clonazepam, lamotrigine, tiagabine, pregabalin, topiramate, levetiracetam, oxcarbazepine, and zonisamide (see Chronic Pain Guideline). Anticonvulsant agents have been used to treat and prevent rotator cuff tendinopathies (324).

ANTI-CONVULSANTS FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHIES

Not Recommended

Anti-convulsants including topiramate, gabapentin, or pregabalin are not recommended for treatment of acute, subacute, or chronic shoulder pain including rotator cuff tendinopathies. Gabapentin is separately reviewed for perioperative use.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies assessing the use of anti-convulsant agents for patients with shoulder pain. By analogy, there is quality evidence that gabapentin is ineffective (see Low Back Disorders), and thus these medications are not recommended for treatment of shoulder pain and rotator cuff tendinopathies. However, there is quality evidence that gabapentin reduces need for opioids when administered as part of perioperative surgery patients' pain management and thus perioperative gabapentin use may be helpful for its opioids-sparing potential (Bang et al., 2010, Pandey et al., 2004, Pandey et al., 2005, Radhakrishnan et al., 2005, Turan et al., 2004).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Anticonvulsant Agents; anticonvulsants, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 12 articles in PubMed, 294 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 5 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google

Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Gabapentin; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 7 articles in PubMed, 2486 in Scopus, 4 in CINAHL, 10 in Cochrane Library, 33 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 3 articles considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

GABAPENTIN FOR PERIOPERATIVE TREATMENT OF ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for gabapentin for perioperative treatment of rotator cuff tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is conflicting quality evidence regarding whether gabapentin improves outcomes and/or reduces need for opioids when administered as part of perioperative shoulder surgery patients' pain management and thus there is no recommendation regarding perioperative use of gabapentin (Bang et al., 2010, Spence et al., 2011). Spence reported no beneficial adjunctive effect in addition to an interscalene block (Spence et al., 2011). A beneficial effect has been described for other types of surgery elsewhere (Pandey et al., 2005, Pandey et al., 2004, Radhakrishnan et al., 2005, Turan et al., 2004).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Anticonvulsant Agents; anticonvulsants, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 12 articles in PubMed, 294 in Scopus, 0 in

CINAHL, 0 in Cochrane Library, 5 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Gabapentin; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 7 articles in PubMed, 2486 in Scopus, 4 in CINAHL, 10 in Cochrane Library, 33 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 3 articles considered for inclusion, 2 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.6.4. OPIOIDS

See the ACOEM Opioids Guideline for recommendations and evidence.

4.6.6.5. SKELETAL MUSCLE RELAXANTS

Skeletal muscle relaxants comprise a diverse set of pharmaceuticals designed to produce muscle relaxation through different mechanisms of action, generally considered to be effects on the central nervous system (CNS) and not on skeletal muscle (325) (326). These medications are widely used in primary care to treat painful conditions, most prominently spine pain (327) (328) (329) (330) (331) (332) (333), muscle spasms (334), and myalgias. They are sometimes used to treat shoulder disorders, but are generally not indicated for chronic shoulder pain (335) (336).

MUSCLE RELAXANTS FOR ACUTE OR SUBACUTE SHOULDER PAIN INCLUDING ROTATOR CUFF TENDINOPATHIES WITH SIGNIFICANT MUSCLE SPASM

Recommended

Muscle relaxants are selectively recommended for acute or subacute, moderate to severe shoulder pain including rotator cuff tendinopathies from muscle spasm that is unrelieved by NSAIDs, avoidance of exacerbating exposures, or other measures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Moderate to severe acute and subacute shoulder pain with significant muscle spasm. This includes rotator cuff tendinopathies and post-operative use.

Benefits

Modest reduction in pain compared with placebo anticipated based on analogies to spine pain.

Harms

Sedation, daytime fatigue. Modest potential for abuse. Risk for safety including motor vehicle crash and other injuries.

Frequency/Dose/Duration

Initial dose in evening (not during workdays or if patient operates a motor vehicle, though daytime use acceptable if minimal CNS-sedating effects). If significant daytime somnolence results, particularly if it interferes with performance of conditioning exercises and other components of the rehabilitation process or treatment plan, discontinue or prescribe a reduced dose. Duration for exacerbations of chronic pain is limited to a couple weeks. Longer term treatment is generally not indicated.

Indications for Discontinuation

Resolution of pain, non-tolerance, significant sedating effects that carry over into the daytime, other adverse effects.

Rationale

There are no quality studies of these agents for treatment of patients with shoulder pain. Skeletal muscle relaxants have been evaluated in quality studies evaluating chronic back and neck [638-640], although there are far more studies of acute LBP (see Chronic Pain, Low Back Disorders, and Cervical and Thoracic Spine Guideline) (Salzmann et al., 1992). The quality of the studies comparing these agents to placebo are likely overstated due to the unblinding that would be inherent in taking a drug with substantial CNS-sedating effects. The adverse effect profile is concerning (Lofland et al., 2001), with CNS-sedation rates ranging from approximately 25 to 50% and a low, but definite, risk of abuse (Littrell et al., 1993, Toth et al., 2004). Thus, prescriptions for skeletal muscle relaxants for daytime use should be carefully weighed against the need to drive vehicles, operate machinery, or otherwise engage in occupations where mistakes in judgment may have serious consequences (e.g., crane operators, air traffic controllers, operators of motorized vehicles, construction workers, etc.). Skeletal muscle relaxants have beneficial uses, particularly for nocturnal administration to normalize sleep patterns disrupted by skeletal muscle pain, as well as for daytime use among the few patients who do not suffer from CNS depressant effects and are low cost if generic medications are prescribed. Skeletal muscle relaxants are not recommended for continuous management of subacute or chronic shoulder pain, although they may be reasonable options for select acute pain exacerbations or for a limited trial as a third- or fourth-line agent in more severely affected patients in whom NSAIDs and exercise have failed to control symptoms. Also not recommended for mild pain as other treatments are typically effective with lower adverse effects. Carisoprodol is not recommended due to its abuse potential.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Skeletal Muscle Relaxants; muscle relaxants, neuromuscular agents, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 31 articles in PubMed, 614 in Scopus, 1 in CINAHL, 0 in Cochrane Library, 28 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.6.6. SYSTEMIC GLUCOCORTICOSTEROIDS

Systemic glucocorticosteroids have been used for the treatment of rotator cuff tendinopathies (337) (338). Glucocorticosteroid injections are reviewed separately.

ORAL GLUCOCORTICOSTEROIDS FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Oral glucocorticosteroids are not recommended for treatment of acute, subacute, or chronic shoulder pain or rotator cuff tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is quality evidence that glucocorticosteroids injected in the subacromial space are effective for treatment of rotator cuff tendinopathies. However, there are no quality placebo-controlled trials of oral glucocorticoids. There is one moderate quality trial that compared subacromial injection with intramuscular, with some outcomes suggesting injections are superior and no outcomes suggesting intramuscular administrations are superior (Ekeberg et al., 2009). Oral glucocorticoids have significant adverse effects, and without evidence of efficacy, they are not recommended for treatment of acute, subacute, or chronic shoulder pain including rotator cuff tendinopathies.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Systemic Glucocorticosteroids; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective,

prospective studies. We found and reviewed 0 articles in PubMed, 18 in Scopus, 31 in CINAHL, 1 in Cochrane Library, 413 in Google Scholar, and 2 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 4 articles considered for inclusion, 1 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.6.7. TOPICAL MEDICATIONS AND LIDOCAINE PATCHES

Topical medications include patches, capsaicin and sports creams, NSAIDs, wheatgrass cream, dimethyl sulfoxide (DMSO), N-acetylcysteine (NAC), and eutectic mixture of local anesthetics (EMLA). Topical glyceryl trinitrate has been utilized for treatment of rotator cuff disease (339). Capsaicin is applied to the skin as a cream or ointment. Possible mechanisms for pain reduction include distraction by stimulating other nerve endings or killing afferent sensory nerve fibers that subsequently regenerate. Rado-Salil ointment is a proprietary formulation of 14 agents, the two most common are menthol (55.1%) and methylsalicylate (26.5%). There are many other commercial products that similarly cause a warm or cool feeling in the skin. All of these agents are thought to work through a counter-irritant mechanism (i.e., feel the dermal sensation rather than the pain). Topical NSAIDs have been used to treat many different MSDs, including arthritis, lateral epicondylitis, and other tendinoses (340) (341). Many different NSAIDs are compounded, including ibuprofen, naproxen, ketoprofen, piroxicam, and diclofenac.

Capsicum creams are frequently categorized as an herbal, topical treatment used for pain management (342). Topical NSAIDS have been used for pain management (343) (344). Topical glyceryl trinitrate has been used to treat or prevent rotator cuff tendinopathies (345) (339) (346). Topical lidocaine patches have been used to treat pain from rotator cuff tendinopathies (347) (348) (349) (350) (351) (352) (353). Eutectic mixture of local anesthetics provides treatment for patients with rotator cuff tendinopathy (354). Topical creams have been used to treat rotator cuff tendinopathies (339) (345) (355) (346) (356) (357).

CAPSICUM CREAMS FOR ACUTE, SUBACUTE, CHRONIC SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHY

Not Recommended

Capsicum is not recommended for treatment of shoulder pain or rotator cuff tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies of capsicum for treatment of rotator cuff tendinopathies. The target tissue

is deep, resulting in difficulty of the medication reaching target tissue and thus capsicum is not recommended for treatment of rotator cuff tendinopathies.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Capsicum Creams; capsaicin, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 927 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 25 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TOPICAL NSAIDS (INCLUDING DICLOFENAC EPOLAMINE) FOR SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHY

Not Recommended

Topical NSAIDs, including diclofenac epolamine, are not recommended for rotator cuff tendinopathy or other shoulder pain as the target tissue is likely too deep to be treated topically.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies of topical NSAIDs to guide efficacy, the target tissue is deep resulting in doubt regarding successful penetration to the target tissue, and thus topic NSAIDs are not recommended for treatment of rotator cuff tendinopathies. There is moderate quality evidence that diclofenac epolamine modestly accelerates clearing of a hematoma on a limb (Klainguti et al., 2010, Hoffmann et al., 2012), resulting in potential highly selective use of that relatively costly treatment. However, in general, there is not a need to treat most hematomas as they are self-resolving.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Topical NSAIDS; anti-inflammatory agents, non-steroidal, administration, topical, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly;

systematic, systematic review, retrospective, prospective studies. We found and reviewed 116 articles in PubMed, 445 in Scopus, 7 in CINAHL, 0 in Cochrane Library, 27 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 1 article considered for inclusion, 1 randomized control trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TOPICAL GLYCERYL TRINITRATE FOR SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHY

Not Recommended

Topical glyceryl trinitrate is not recommended for rotator cuff tendinopathy or other shoulder pain as the target tissue is likely too deep to be treated topically.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies of size to guide efficacy for any of these agents. However, there are some quality studies suggesting short- to intermediate-term benefits for some of these agents for more superficial tissues (see Chronic Pain Guideline, Elbow Disorders, Hand, Wrist, and Forearm Disorders). These agents, when demonstrated to have efficacy, appear weakly effective. They might cause deleterious effects if used long-term. Topical applications of anesthetic agents such as lidocaine over large areas are thought to carry significant risk of potentially fatal adverse effects (FDA, 2009). As there is no quality evidence of efficacy and the target tissue is deep, these topical agents are not recommended for treatment of shoulder pain and rotator cuff tendinopathy.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Topical Glyceryl Trinitrate; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 8 articles in PubMed, 306 in Scopus, 3 in CINAHL, 3 in Cochrane Library, 39 in Google Scholar, and 1 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 4 articles considered for inclusion, 1 randomized trial and 3 systematic reviews met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

LIDOCAINE PATCHES FOR SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHY

Not Recommended

Lidocaine patches are not recommended for rotator cuff tendinopathy or other shoulder pain as the target tissue is likely too deep to be treated topically.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies of size to guide efficacy for any of these agents. However, there are some quality studies suggesting short- to intermediate-term benefits for some of these agents for more superficial tissues (see Chronic Pain Guideline, Elbow Disorders, Hand, Wrist, and Forearm Disorders). These agents, when demonstrated to have efficacy, appear weakly effective. They might cause deleterious effects if used long-term. Topical applications of anesthetic agents such as lidocaine over large areas are thought to carry significant risk of potentially fatal adverse effects (FDA, 2009). As there is no quality evidence of efficacy and the target tissue is deep, these topical agents are not recommended for treatment of shoulder pain and rotator cuff tendinopathy.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Lidocaine Patches; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 1827 articles in PubMed, 143 in Scopus, 26 in CINAHL, 60 in Cochrane Library, 113 in Google Scholar, and 0 from other sources†. We considered for inclusion 3 from PubMed, 4 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 7 articles considered for inclusion, 1 randomized trials and 4 systematic reviews met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EUTECTIC MIXTURE OF LOCAL ANESTHETICS (EMLA) FOR SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHY

Not Recommended

Eutectic mixture of local anesthetics (EMLA) is not recommended for rotator cuff tendinopathy or other shoulder pain as the target tissue is likely too deep to be treated topically.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies of size to guide efficacy for any of these agents. However, there are some quality studies suggesting short- to intermediate-term benefits for some of these agents for more superficial tissues (see Chronic Pain Guideline, Elbow Disorders, Hand, Wrist, and Forearm Disorders). These agents, when demonstrated to have efficacy, appear weakly effective. They might cause deleterious effects if used long-term. Topical applications of anesthetic agents such as lidocaine over large areas are thought to carry significant risk of potentially fatal adverse effects (FDA, 2009). As there is no quality evidence of efficacy and the target tissue is deep, these topical agents are not recommended for treatment of shoulder pain and rotator cuff tendinopathy.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Eutectic Mixture of Local Anesthetics; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 1 article in PubMed, 26 in Scopus, 1 in CINAHL, 1 in Cochrane Library, 13 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 randomized trials and 0 systematic reviews met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

OTHER CREAMS/OINTMENTS FOR SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHY

Not Recommended

Other creams/ointments are not recommended for rotator cuff tendinopathy or other shoulder pain as the target tissue is likely too deep to be treated topically.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies of size to guide efficacy for any of these agents. However, there are some quality studies suggesting short- to intermediate-term benefits for some of these agents for more superficial tissues (see Chronic Pain Guideline, Elbow Disorders, Hand, Wrist, and Forearm Disorders). These agents, when demonstrated to have efficacy, appear weakly effective. They might cause deleterious effects if used long-term. Topical applications of anesthetic agents such as lidocaine over large areas are thought to carry significant risk of potentially fatal adverse effects (FDA, 2009). As there is no quality evidence of efficacy and the target tissue is deep, these topical agents are not recommended for treatment of shoulder pain and rotator cuff tendinopathy.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Agropyron, Dimethyl Sulfoxide, Acetylcysteine, glyceryl trinitrate; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 19 articles in PubMed, 198 in Scopus, 13 in CINAHL, 7 in Cochrane Library, 53 in Google Scholar, and 0 from other sources†. We considered for inclusion 5 from PubMed, 0 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 1 randomized trials and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.6.8. OTHER MEDICATIONS

Omega-3 polyunsaturated fatty acids has been used to treat rotator cuff tendinopathies (358) (359) (360). Statins have been used to prevent and treat rotator cuff tendinopathy (360) (361) (362) (363).

OMEGA-3-POLYUNSATURATED FATTY ACIDS FOR ROTATOR CUFF TENDINOPATHY

Not Recommended

Omega-3-polyunsaturated fatty acids are not recommended to treat rotator cuff tendinopathy.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Low

Rationale

One high-quality RCT suggests a lack of efficacy (Sandford et al., 2018). Thus, omega-3-polyunsaturated fatty acids are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Omega-3-polyunsaturated fatty acids; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 2 articles in PubMed, 109 in Scopus, 5 in CINAHL, 0 in Cochrane Library, 10 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google

Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 2 randomized trials and 1 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

STATINS FOR ROTATOR CUFF TENDINOPATHY

No Recommendation

There is no recommendation for or against the use of statins to treat rotator cuff tendinopathy.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials of statins for treatment of rotator cuff tendinopathy, although there is evidence that lipid disorders and cardiovascular disease risk factors are risk factors for rotator cuff tendinopathies. Because there is no quality evidence of efficacy specifically for the treatment of rotator cuff tendinopathies, there is no recommendation regarding this indication.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Statins or Hydroxymethylglutaryl-CoA Reductase Inhibitors; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 6 articles in PubMed, 203 in Scopus, 6 in CINAHL, 0 in Cochrane Library, 4 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.7. DEVICES

4.6.7.1. SLINGS, BRACES, AND SHOULDER SUPPORTS

Slings, braces, and shoulder supports have been used to help stabilize the shoulder and rotator cuff during treatment (364) (365) (366) (367) (368) (369) (370) (371) (372). Immobilization has been used

to promote healing in rotator cuff tendinopathies after surgical intervention (373) (374) (375) (376) (377) (378) (379).

SLINGS, BRACES, AND SHOULDER SUPPORTS FOR ACUTE SEVERE SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHY

Sometimes Recommended

Slings and shoulder supports are selectively recommended for use only for acute severe pain when the appliance is used to briefly rest the shoulder and then promptly but gradually advance the activity level. This includes brief, post-operative use of slings and braces. Slings are not recommended for use in subacute or chronic pain. Longer use may be selectively indicated for significant trauma and post-operatively, although a range-of-motion program is still generally indicated.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Acute severe shoulder pain, either traumatic or atraumatic, particularly where the appliance is utilized as part of a plan to briefly rest the shoulder and promptly, gradually increase activity level. Non-operative patients are recommended to have a ROM exercise program instituted in nearly all circumstances. Severe trauma may require more extended use, although concomitant range of motion exercises are still generally indicated. Post-operative use is also an indication and timing of, and institution of concomitant exercises is to be guided by the treating surgeon with longer use sometimes indicated; however importantly, one RCT has suggested improved outcomes if rehabilitation of a small- to medium-sized tear is accomplished without use of a sling (Tirefort et al., 2019).

Benefits

Short-term improvement in pain

Harms

Delayed recovery, development of adhesive capsulitis and debility.

Indications for Discontinuation

Generally should be weaned off within 3-5 days, especially for non-operative patients. Post-operatively, evidence suggests 3 weeks in a simple sling is not inferior to 6 weeks in a mobilization brace with assessments out to 12 months (Jenssen et al., 2018), and there is evidence that immobilization results in worse functional outcomes at 6 months (Tirefort et al., 2019), resulting in some indications to advance exercises earlier rather than later.

Rationale

There are no quality studies for acute shoulder pain. There are several RCTs of post-arthroscopic surgery for either small- or medium-sized rotator cuff tears or impingement syndrome. One trial found no differences between 3 weeks in a sling and 6 weeks in a brace for small- to medium-sized rotator cuff tears (Jenssen et al., 2018). Another trial found no differences between early mobilization for 6 weeks with PRN sling use compared with 6 weeks in a sling without active shoulder ROM (Sheps et al., 2019). Another trial suggested that an abduction brace was not superior to the anti-rotation sling after arthroscopic cuff repair (Hollman et al., 2017). Another trial found no additive value of sling use for 4

weeks after arthroscopic repair of small to medium sized tears when added to passive mobilization of the shoulder for 4 weeks and then progressive mobilization (Tirefort et al., 2019).

Thus, there is not quality evidence that supports use of a sling for either acute pain or post-operative pain. Theoretically, short-term use of slings and supports may help with short-term pain reductions. However, they come with considerable increased risks of adhesive capsulitis, delayed recovery and increased debility. Thus, slings and supports are selectively recommended for only acute severe shoulder pain and short-term post-operative use. Range-of-motion exercises are generally advised (e.g., pendulum, wall-walks) during the time when using the sling. Generally wean off the support use within 1-2 weeks.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Slings, Braces, Shoulder Supports; orthotic devices, orthoses, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 64 articles in PubMed, 566 in Scopus, 29428 in CINAHL, 43 in Cochrane Library, 391 in Google Scholar, and 1 from other sources†. We considered for inclusion 4 from PubMed, 2 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 11 articles considered for inclusion, 7 randomized trials and 1 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Post- Operative Immobilization; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 48 articles in PubMed, 1491 in Scopus, 29203 in CINAHL, 7 in Cochrane Library, 593 in Google Scholar, and 0 from other sources†. We considered for inclusion 4 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 5 articles considered for inclusion, 1 randomized trial and 4 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If

relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SLINGS AND SHOULDER SUPPORTS FOR SUBACUTE SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHY

Not Recommended

Slings and shoulder supports are not recommended for either subacute or chronic shoulder pain or for mild to moderate acute pain.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is one moderate-quality trial of a sling for treatment of disabling impingement syndrome, but it failed to find evidence of efficacy (Walther et al., 2004). As there is no evidence of efficacy in chronic pain patients, and there are considerable adverse effects, slings and supports are not indicated in subacute or chronic shoulder pain patients.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Slings, Braces, Shoulder Supports; orthotic devices, orthoses, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 64 articles in PubMed, 566 in Scopus, 29428 in CINAHL, 43 in Cochrane Library, 391 in Google Scholar, and 1 from other sources†. We considered for inclusion 4 from PubMed, 2 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 11 articles considered for inclusion, 7 randomized trials and 1 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Post- Operative Immobilization; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 48 articles in PubMed, 1491 in Scopus, 29203 in CINAHL, 7 in Cochrane Library, 593 in Google Scholar, and 0 from other sources†. We considered for inclusion

4 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 5 articles considered for inclusion, 1 randomized trial and 4 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SLINGS OR SHOULDER SUPPORTS FOR CHRONIC SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHY

Not Recommended

Slings and shoulder supports are not recommended for either subacute or chronic shoulder pain or for mild to moderate acute pain.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Moderate

Rationale

There is one moderate-quality trial of a sling for treatment of disabling impingement syndrome, but it failed to find evidence of efficacy (Walther et al., 2004). As there is no evidence of efficacy in chronic pain patients, and there are considerable adverse effects, slings and supports are not indicated in subacute or chronic shoulder pain patients.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Slings, Braces, Shoulder Supports; orthotic devices, orthoses, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 64 articles in PubMed, 566 in Scopus, 29428 in CINAHL, 43 in Cochrane Library, 391 in Google Scholar, and 1 from other sources†. We considered for inclusion 4 from PubMed, 2 from Scopus, 0 from CINAHL, 2 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 11 articles considered for inclusion, 7 randomized trials and 1 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Post- Operative Immobilization; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 48 articles in PubMed, 1491 in Scopus, 29203 in CINAHL, 7 in Cochrane Library, 593 in Google Scholar, and 0 from other sources†. We considered for inclusion 4 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 5 articles considered for inclusion, 1 randomized trial and 4 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.7.2. TAPING AND KINESIOTAPING

Taping (non-elastic, thick tape) and kinesiotaping (elastic, thinner tape) are used on the extremities, particularly in sports settings, as well as the shoulder (380) (381) (382) (383) (384) (385) (386) (387). Taping (white athletic taping, cotton mesh adhesive tape often over gauze) is intended to stabilize and support, but restrict ROM, and thus is used for purported treatment and preventive purposes (388) (389) (390) (391). It is often utilized immediately prior to an activity and then removed, or the cotton mesh may be applied and removed after hours of use. Kinesiotaping has also been used for treatment, including pain relief; however, it is intended to allow full ROM in contrast with traditional taping (384) (385) (390) (392) (393) (394) (395) (396) (397) (398). Kinesiotaping is proprietary; proponents believe the tape should be applied in specific patterns and may or may not be stretched depending on the injury. Regardless, all types of taping are utilized to attempt to treat musculoskeletal disorders. Difficulty with tolerating the various types of tape may be problematic for some patients.

TAPING OR KINESIOTAPING FOR SHOULDER PAIN AND ROTATOR CUFF TENDINOPATHY

Not Recommended

Taping or kinesiotaping is not recommended for treatment of shoulder pain and rotator cuff tendinopathy.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Low

Rationale

Two sham-controlled trials found lack of efficacy (Kang et al., 2019, Kocyigit et al., 2016). A post-operative, sham-controlled trial also found lack of efficacy (Reynard et al., 2018). One high-quality, but very short-term, trial of kinesiotaping for treatment of shoulder pain failed to show improvements in pain (Thelen et al., 2008). A moderate-quality study reported the results were related to expectations and psychological conditioning (Analay Akbaba et al., 2018). Taping and kinesiotaping have sham-controlled evidence of lack of efficacy and thus they are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Taping and Kinesiotaping; athletic tape, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 41 articles in PubMed, 112 in Scopus, 38869 in CINAHL, 27 in Cochrane Library, 91 in Google Scholar, and 4 from other sources†. We considered for inclusion 10 from PubMed, 1 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 2 from Google Scholar, and 4 from other sources. Of the 23 articles considered for inclusion, 18 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.7.3. MAGNETS AND MAGNETIC STIMULATION

High-intensity magnetic stimulation purportedly causes depolarization of nerves and has been found to result in an antinociceptive effect in rats (399). Electromagnetic fields have been known to increase osteoblastic activity. Therefore, proponents believe magnetic fields have therapeutic value in the treatment of musculoskeletal disorders. Magnetic field therapies have been used to treat various rotator cuff tendinopathies (400) (401) (402) (403).

MAGNETS AND MAGNETIC STIMULATION FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHY

Not Recommended

Magnets and magnetic stimulation are not recommended for the treatment of acute, subacute, or chronic shoulder pain or rotator cuff tendinopathy.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

One trial assessing additive value of EMTT to EWST reported evidence of efficacy (Klüter et al., 2018). However, another sham-controlled trial reported a lack of efficacy (de Freitas et al., 2014). A third trial found evidence pulsed electromagnetic fields had efficacy (Binder et al., 1984). There also is quality evidence for lack of efficacy of magnets in treatment of low back pain (Collacott et al., 2000). Magnets and magnetic fields are not invasive and have no adverse effects; they are low to high cost depending on the type of treatment. Because the data substantially conflict and the underlying theory is problematic, they are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnets, Magnetic Therapy, Magnetic Field Therapies; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 15 articles in PubMed, 246 in Scopus, 7 in CINAHL, 1 in Cochrane Library, 483 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 3 randomized trials and 1 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.7.4. VIBRATION

Vibration has been used to treat rotator cuff tendinopathies (404) (405) (406) (407) (408) (409).

VIBRATION FOR ROTATOR CUFF TENDINOPATHY

Not Recommended

Vibration is not recommended for the treatment of rotator cuff tendinopathy.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Low

Rationale

The only moderate-quality RCTs assessing vibration suggest a lack of efficacy (Lam et al., 2015, Hand et al., 2009), and thus vibration is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Vibration; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 19 articles in PubMed, 2460 in Scopus, 13 in CINAHL, 460 in Cochrane Library, 117 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 4 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 2 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.8. ELECTRICAL THERAPIES

4.6.8.1. INTERFERENTIAL THERAPY

There are multiple forms of electrical therapies used to treat musculoskeletal pain. These include high-voltage galvanic, H-wave® Device Stimulation, interferential therapy (IFT or IT), iontophoresis, microcurrent, percutaneous electrical nerve stimulation (PENS), sympathetic electrotherapy, and transcutaneous electrical stimulation (TENS). The mechanism(s) of action, if any, are unclear.

INTERFERENTIAL THERAPY FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Interferential therapy is not recommended for treatment of rotator cuff tendinopathies.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Low

Rationale

There are moderate-quality study suggesting interferential therapy is ineffective for treating rotator cuff tendinopathies (Gunay Ucurum et al., 2018, Gomes et al., 2018, Van der Heijden et al., 1999), two of which suggested a lack of additive benefit (Gunay Ucurum et al., 2018, Gomes et al., 2018). Only one RCT suggested efficacy (Montes-Molina et al., 2012). Thus, the overall literature base suggests a lack of efficacy and interferential is not recommended for treatment of shoulder pain or rotator cuff tendinopathies.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Interferential Therapy, IFC, Electrical Stimulation; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 25 articles in PubMed, 200 in Scopus, 13 in CINAHL, 20 in Cochrane Library, 84 in Google Scholar, and 1 from other sources†. We considered for inclusion 5 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 10 articles considered for inclusion, 5 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms.

Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.8.2. EXTRACORPOREAL SHOCKWAVE THERAPY

Extracorporeal shockwave therapy (ESWT) has been utilized for treatment of shoulder tendinitis (227) (429) (521), (1533) but has been particularly used for calcific tendinitis (521) (1534) (1535) (1536) (1537) (1538) (1539) (1540) (1541). Calcific tendinitis should be diagnosed with imaging for confirmation of presence of calcium. However, there have been some challenges noted in interpreting studies of efficacy including amount of energy delivered, method of focusing shock waves, treatment frequency, timing, and use of anesthetics (1537) (1542) (402) (456) (1543) (1544) (1545) (1546) (1547) (1548) (1549) (1550) (1541) (1551) (1551) (1552) (1553) (1554) (1555) (1556) (1557) (1558) (1559) (1560) (1561) (1562).

EXTRACORPOREAL SHOCKWAVE THERAPY FOR CHRONIC SHOULDER PAIN OR NON-CALCIFIC ROTATOR CUFF TENDINITIS

Not Recommended

Extracorporeal shockwave therapy is not recommended for treatment of acute, subacute, or chronic non-calcific rotator cuff tendinitis.
Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Rationale

There are five moderate-quality trials evaluating efficacy of ESWT for treatment of patients with chronic, non-calcific tendinitis or impingement syndrome (Kvalvaag, 2017, Schmitt et al., 2001, Speed et al., 2002, Schofer et al., 2009, Galasso et al., 2012, Engebretsen et al., 2011). Five of the six studies suggest a lack of efficacy (Kvalvaag, 2017, Schmitt et al., 2001, Speed, 2004, Schofer et al., 2009, Engebretsen et al., 2011), while two smaller studies have suggested efficacy (Santamato A, 2016, Galasso et al., 2012). There are other treatments reviewed elsewhere with documented efficacy for treatment of these patients. ESWT is minimally invasive as often performed with an injected anesthetic, has some adverse effects, is moderate to high cost depending on numbers of treatments, and appears ineffective. Thus, with evidence of inefficacy accruing, it is not recommended for treatment of non-calcific rotator cuff tendinitis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Extracorporeal Shockwave Therapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 14 articles in PubMed, 592 in Scopus, 28957 in CINAHL, 62 in Cochrane Library, 338 in Google Scholar, and 29 from other sources†. We considered for inclusion 4 from PubMed, 5 from Scopus, 0 from CINAHL, 5 from Cochrane Library, 3 from Google

Scholar, and 29 from other sources. Of the 46 articles considered for inclusion, 33 randomized trials and 13 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EXTRACORPOREAL SHOCKWAVE THERAPY FOR ACUTE OR SUBACUTE SHOULDER PAIN OR NON-CALCIFIC ROTATOR CUFF TENDINITIS

Not Recommended

Extracorporeal shockwave therapy is not recommended for treatment of acute, subacute, or chronic non-calcific rotator cuff tendinitis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There are five moderate-quality trials evaluating efficacy of ESWT for treatment of patients with chronic, non-calcific tendinitis or impingement syndrome (Kvalvaag, 2017, Schmitt et al., 2001, Speed et al., 2002, Schofer et al., 2009, Galasso et al., 2012, Engebretsen et al., 2011). Five of the six studies suggest a lack of efficacy (Kvalvaag, 2017, Schmitt et al., 2001, Speed, 2004, Schofer et al., 2009, Engebretsen et al., 2011), while two smaller studies have suggested efficacy (Santamato A, 2016, Galasso et al., 2012). There are other treatments reviewed elsewhere with documented efficacy for treatment of these patients. ESWT is minimally invasive as often performed with an injected anesthetic, has some adverse effects, is moderate to high cost depending on numbers of treatments, and appears ineffective. Thus, with evidence of inefficacy accruing, it is not recommended for treatment of non-calcific rotator cuff tendinitis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Extracorporeal Shockwave Therapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 14 articles in PubMed, 592 in Scopus, 28957 in CINAHL, 62 in Cochrane Library, 338 in Google Scholar, and 29 from other sources†. We considered for inclusion 4 from PubMed, 5 from Scopus, 0 from CINAHL, 5 from Cochrane Library, 3 from Google Scholar, and 29 from other sources. Of the 46 articles considered for inclusion, 33 randomized trials and 13 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If

relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EXTRACORPOREAL SHOCKWAVE THERAPY FOR CALCIFIC ROTATOR CUFF TENDINITIS

Recommended

Extracorporeal shockwave therapy is strongly recommended for treatment of chronic calcific rotator cuff tendinitis.
Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

Indications

Symptomatic calcific rotator cuff tendinitis that has been diagnosed with imaging. Patients should have failed at least 3 months of time with symptoms without resolution as well as failed physical or occupational therapy with both active and passive exercises, NSAIDs, and glucocorticosteroid injection(s) (Gerdesmeyer et al., 2003, Peters et al., 2004, Albert et al., 2007, Hsu et al., 2008, Hearnden, 2009, Pleiner et al., 2004, Cacchio, 2006, Sabeti et al., 2007). Evidence also suggests ultrasound-guided needling appears superior to EWST for calcium deposit resolution (Louwerens et al., 2020, Kim et al., 2014, Del Castillo et al., 2016), and 2 of the 3 studies also suggest it is also superior for pain and/or function (Kim et al., 2014, Del Castillo et al., 2016). Thus, there is consideration for that procedure prior to consideration of ESWT. Should a patient fail those interventions ahead of 3-6 months, then ESWT may be an option.

Benefits

Improved pain, function, and disappearance of calcium deposits.

Harms

Short-term pain.

Frequency/Dose/Duration

Treatment frequency and duration patterns varied in quality studies. These ranged from a single session (Hearnden, 2009, Sabeti et al., 2007, Krasny et al., 2005) to a second session in 1 week (Haake et al., 2002) to weekly sessions for 4 weeks (Cacchio, 2006) to an average of 4 sessions every 6 weeks over 6 months (Peters et al., 2004). Most commonly and including the highest quality studies, patients were treated with 2 sessions that were approximately 14 days apart. (Gerdesmeyer et al., 2003, Albert et al., 2007, Hsu et al., 2008, Pleiner et al., 2004, Pan et al., 2003). Thus, up to 2 sessions, approximately 2 weeks apart are recommended. Energy levels with documented success varied as well, ranging from 0.28 to 0.55 mJ/mm2 in the most successful quality sham-controlled trials (Gerdesmeyer et al., 2003, Peters et al., 2004, Albert et al., 2007, Hsu et al., 2008, Hearnden, 2009, Pleiner et al., 2004). There is evidence that low energy levels such as 0.15 mJ/mm2 are less effective (Peters et al., 2004). Thus, while an optimal dose is unclear, the recommended dose ranges from 0.28 to 0.55 mJ/mm2. There is evidence that positioning of the arm in hyperextension and internal rotation is superior (Tornese et al., 2011). There is quality evidence the focus should be on the calcium deposits and not the tendon insertion (Haake et al., 2002). Some protocols combined this therapy with an exercise program.

Indications for Discontinuation

Resolution, intolerance, non-compliance.

Rationale

There are three high-quality (Gerdesmeyer et al., 2003, Peters et al., 2004, Cacchio, 2006) and seven moderate-quality trials (Albert et al., 2007, Hsu et al., 2008, Hearnden, 2009, Pleiner et al., 2004, Sabeti et al., 2007, Kolk et al., 2013, Ioppolo et al., 2012) comparing extracorporeal shockwave therapy with either sham or low energy for treatment of chronic calcific tendinitis. The quality literature nearly uniformly supports efficacy of ESWT for treatment of calcific tendinitis whether measured by pain, function, or disappearance of calcium deposits on x-rays (Gerdesmeyer et al., 2003, Peters et al., 2004, Albert et al., 2007, Hsu et al., 2008, Hearnden, 2009, Pleiner et al., 2004, Cacchio, 2006, Sabeti et al., 2007). There also is evidence of efficacy compared with treatment with TENS (Pan et al., 2003). There is a low-quality study suggesting that surgical extirpation of calcium deposits is equally effective compared with ESWT (Rompe et al., 2001). Needling is sometimes used as an adjunct, has some evidence of efficacy, and is reviewed elsewhere (Krasny et al., 2005). There are no RCTs comparing ESWT with ultrasound-guided needling, which makes a direct comparison and recommendation between these treatments difficult (Louwerens et al., 2014). ESWT is minimally invasive (Louwerens et al., 2014), as it is often performed with an injected anesthetic, has some adverse effects, is moderate to high cost depending on the number of treatments yet is quite effective. Thus, it is strongly recommended for treatment of calcific rotator cuff tendinitis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Extracorporeal Shockwave Therapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 14 articles in PubMed, 592 in Scopus, 28957 in CINAHL, 62 in Cochrane Library, 338 in Google Scholar, and 29 from other sources†. We considered for inclusion 4 from PubMed, 5 from Scopus, 0 from CINAHL, 5 from Cochrane Library, 3 from Google Scholar, and 29 from other sources. Of the 46 articles considered for inclusion, 33 randomized trials and 13 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.8.3. PULSED ELECTROMAGNETIC FIELD THERAPY

Pulsed electromagnetic field therapy (PEMF) is used to treat rotator cuff tendinopathies (257) (400) (401) (402)(410) (411) (412) (413) (403) (414) (260).

PULSED ELECTROMAGNETIC FIELD FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Pulsed electromagnetic field (PEMF) is moderately not recommended for treatment of acute, subacute, or chronic shoulder pain or rotator cuff tendinopathies.
Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Rationale

There are two quality studies of PEMF suggesting lack of benefit, which include a high-quality sham-controlled trial (Aktas I, 2007). Thus, treatment with pulsed electromagnetic fields is not recommended for treatment of rotator cuff tendinopathies.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Pulsed Electromagnetic Field Therapy, Pulsed Electromagnetic Field, PEFT, Low Field Magnetic Stimulation; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 20 articles in PubMed, 188 in Scopus, 11 in CINAHL, 16 in Cochrane Library, 75 in Google Scholar, and 7 from other sources†. We considered for inclusion 3 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 7 from other sources. Of the 11 articles considered for inclusion, 3 randomized trials and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.8.4. ELECTRICAL MUSCLE STIMULATION

Neuromuscular electrical stimulation has been used to treat rotator cuff tendinopathy (415).

ELECTRICAL MUSCLE STIMULATION (EMS) FOR ROTATOR CUFF TENDINOPATHY

No Recommendation

There is no recommendation for electrical muscle stimulation for treatment of rotator cuff tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials and thus there is no recommendation for electrical muscle stimulation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Electrical Muscle Stimulation, Neuromuscular Electrical Stimulation; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 54 articles in PubMed, 5,702 in Scopus, 178 in CINAHL, 14 in Cochrane Library, 233 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.8.5. TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION

Transcutaneous electrical nerve stimulation (TENS) has been used to treat rotator cuff injuries (248) (249) (250) (251) (252) (253) (416) (417) (418) (419) (420) (421) (422) (423).

TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION FOR TREATMENT OF ROTATOR CUFF TENDINOPATHIES

Sometimes Recommended

Transcutaneous electrical nerve stimulation (TENS) is selectively recommended for chronic rotator cuff tendinopathies and post-operative use as an adjunct for pain control.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Moderate to severe and chronic rotator cuff tendinopathies that have been insufficiently addressed by exercises, NSAIDs, and injection. Post-operative use has been suggested to reduce pain and opioids consumption (Mahure et al., 2017).

Benefits

Improved pain control. Reduced post-operative opioids use.

Harms

Negligible. Possible externalization and medicalization away from an active rehabilitation program.

Frequency/Dose/Duration

Use 3-5 times/day is typical.

Indications for Discontinuation

Sufficient recovery, intolerance, and non-compliance.

Rationale

A post-operative sham-controlled study suggested TENS reduced pain and opioids use compared with sham (Mahure et al., 2017). A comparative trial suggested superiority of electroacupuncture to TENS (Yoshimizu, 2012). One RCT found transcutaneous pulsed radiofrequency (TPRF) superior to TENS (Lin et al., 2019). One RCT suggested potential evidence of efficacy based on functional MRI but no clinical outcomes (Kocyigit, 2012). TENS is non-invasive, has low adverse effects, but is moderate to high cost when examined in aggregate. As there is evidence suggesting efficacy, particularly in the post-operative setting, TENS is selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Transcutaneous Electrical Stimulation, TENS; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 54 articles in PubMed, 662 in Scopus, 88 in CINAHL, 32 in Cochrane Library, 246 in Google Scholar, and 6 from other sources†. We considered for inclusion 7 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 6 from other sources. Of the 15 articles considered for inclusion, 8 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.8.6. MICROCURRENT

Microcurrent has been used to treat rotator cuff tendinopathies (424) (425).

MICROCURRENT FOR TREATMENT OF ROTATOR CUFF TENDINOPATHIES

Sometimes Recommended

Microcurrent is selectively recommended for chronic rotator cuff tendinopathies and post-operative use.
Strength of evidence Recommended, Insufficient Evidence (I)

Level of confidence Low

Indications

Moderate to severe and chronic rotator cuff tendinopathies that have been insufficiently addressed by exercises, NSAIDs, and injections.

Benefits

Improved pain control.

Harms

Negligible. Possible externalization and medicalization away from an active rehabilitation program.

Frequency/Dose/Duration

Approximately 1-3 appointments per week in therapy up to 4-6 weeks. Subsequent batches of 4-6 appointments should be based on incremental functional gain.

Indications for Discontinuation

Sufficient recovery, intolerance, and non-compliance.

Rationale

One RCT suggested efficacy (Atya, 2012) and a second suggested comparable efficacy with TENS (Vrouva, 2019). Microcurrent is non-invasive, has low adverse effects, but is moderate to high cost when examined in aggregate. As there is evidence suggesting efficacy, microcurrent is selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Microcurrent; microcurrent therapy, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 2 articles in PubMed, 154 in Scopus, 2 in CINAHL, 2 in Cochrane Library, 10 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.8.7. OTHER ELECTRICAL STIMULATION THERAPIES

Iontophoresis was used to treat rotator cuff tendinopathies (426) (427). H-wave® Device Stimulation has been used to treat rotator cuff tendinopathies (428) (429) (430). High-voltage galvanic stimulation provides pain relief and facilitates in wound healing by the use of high driving voltage up to 500 volts (431) (432). Percutaneous electrical nerve stimulation (PENS) is an analgesic modality used to treat conditions such as low back pain and diabetic neuropathy (433) (434) (435).

HIGH-VOLTAGE GALVANIC STIMULATION FOR THE TREATMENT OF ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of other electrical therapies outside of research settings for treatment of rotator cuff tendinopathies, including high-voltage galvanic, H-wave® Device Stimulation, iontophoresis, percutaneous electrical nerve stimulation (PENS), and sympathetic electrotherapy.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One trial of H-wave® Device Stimulation with invasive electrodes in post-operative rotator cuff tendinopathy patients suggested some modest range-of-motion benefits, but applicability to surface electrodes or to other patients is unknown and further large scale studies were recommended (Blum et al., 2009). The two available RCTs regarding iontophoresis do not clearly suggest efficacy (García, 2016, Leduc, 2003). There are no quality studies for any of the other electrical therapies in occupational populations with rotator cuff tendinopathies. These therapies are mostly non-invasive with low adverse effects, but are moderate to high cost when examined in aggregate. There is no recommendation for or against use of these therapies (high-voltage galvanic, H-wave® Device Stimulation, iontophoresis, percutaneous electrical nerve stimulation, and sympathetic electrotherapy). There are alternate treatments that are effective.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: High-Voltage Galvanic Stimulation; high-voltage galvanic pulsed stimulation, high-voltage galvanism, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 32 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 38 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If

relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

H-WAVE® DEVICE STIMULATION FOR THE TREATMENT OF ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of other electrical therapies outside of research settings for treatment of rotator cuff tendinopathies, including high-voltage galvanic, H-wave® Device Stimulation, iontophoresis, percutaneous electrical nerve stimulation (PENS), and sympathetic electrotherapy.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One trial of H-wave® Device Stimulation with invasive electrodes in post-operative rotator cuff tendinopathy patients suggested some modest range-of-motion benefits, but applicability to surface electrodes or to other patients is unknown and further large scale studies were recommended (Blum et al., 2009). The two available RCTs regarding iontophoresis do not clearly suggest efficacy (García, 2016, Leduc, 2003). There are no quality studies for any of the other electrical therapies in occupational populations with rotator cuff tendinopathies. These therapies are mostly non-invasive with low adverse effects, but are moderate to high cost when examined in aggregate. There is no recommendation for or against use of these therapies (high-voltage galvanic, H-wave® Device Stimulation, iontophoresis, percutaneous electrical nerve stimulation, and sympathetic electrotherapy). There are alternate treatments that are effective.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms H-Wave Stimulation, H-Wave, HWSD; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 2 articles in PubMed, 7 in Scopus, 2 in CINAHL, 1 in Cochrane Library, 4 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 3 articles considered for inclusion, 1 randomized trial and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

IONTOPHORESIS FOR THE TREATMENT OF ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of other electrical therapies outside of research settings for treatment of rotator cuff tendinopathies, including high-voltage galvanic, H-wave® Device Stimulation, iontophoresis, percutaneous electrical nerve stimulation (PENS), and sympathetic electrotherapy.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One trial of H-wave® Device Stimulation with invasive electrodes in post-operative rotator cuff tendinopathy patients suggested some modest range-of-motion benefits, but applicability to surface electrodes or to other patients is unknown and further large scale studies were recommended (Blum et al., 2009). The two available RCTs regarding iontophoresis do not clearly suggest efficacy (García, 2016, Leduc, 2003). There are no quality studies for any of the other electrical therapies in occupational populations with rotator cuff tendinopathies. These therapies are mostly non-invasive with low adverse effects, but are moderate to high cost when examined in aggregate. There is no recommendation for or against use of these therapies (high-voltage galvanic, H-wave® Device Stimulation, iontophoresis, percutaneous electrical nerve stimulation, and sympathetic electrotherapy). There are alternate treatments that are effective.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Iontophoresis; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 15 articles in PubMed, 659 in Scopus, 8 in CINAHL, 2 in Cochrane Library, 176 in Google Scholar, and 1 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 2 articles considered for inclusion, 3 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PERCUTANEOUS ELECTRICAL NERVE STIMULATION (PENS) FOR THE TREATMENT OF ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of other electrical therapies outside of research settings for treatment of rotator cuff tendinopathies, including high-voltage galvanic, H-wave® Device Stimulation, iontophoresis, percutaneous electrical nerve stimulation (PENS), and sympathetic electrotherapy.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One trial of H-wave® Device Stimulation with invasive electrodes in post-operative rotator cuff tendinopathy patients suggested some modest range-of-motion benefits, but applicability to surface electrodes or to other patients is unknown and further large scale studies were recommended (Blum et al., 2009). The two available RCTs regarding iontophoresis do not clearly suggest efficacy (García, 2016, Leduc, 2003). There are no quality studies for any of the other electrical therapies in occupational populations with rotator cuff tendinopathies. These therapies are mostly non-invasive with low adverse effects, but are moderate to high cost when examined in aggregate. There is no recommendation for or against use of these therapies (high-voltage galvanic, H-wave® Device Stimulation, iontophoresis, percutaneous electrical nerve stimulation, and sympathetic electrotherapy). There are alternate treatments that are effective.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Percutaneous Electrical Nerve Stimulation; PENS, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 58 articles in PubMed, 870 in Scopus, 35 in CINAHL, 0 in Cochrane Library, 3 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Sympathetic Electrotherapy, Sympathetic Therapy, Sympathetic Electrical Stimulation Therapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 6 articles in PubMed, 36 in Scopus, 51 in CINAHL, 5 in Cochrane Library, 222 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from

Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SYMPATHETIC ELECTROTHERAPY FOR THE TREATMENT OF ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of other electrical therapies outside of research settings for treatment of rotator cuff tendinopathies, including high-voltage galvanic, H-wave® Device Stimulation, iontophoresis, percutaneous electrical nerve stimulation (PENS), and sympathetic electrotherapy.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One trial of H-wave® Device Stimulation with invasive electrodes in post-operative rotator cuff tendinopathy patients suggested some modest range-of-motion benefits, but applicability to surface electrodes or to other patients is unknown and further large scale studies were recommended (Blum et al., 2009). The two available RCTs regarding iontophoresis do not clearly suggest efficacy (García, 2016, Leduc, 2003). There are no quality studies for any of the other electrical therapies in occupational populations with rotator cuff tendinopathies. These therapies are mostly non-invasive with low adverse effects, but are moderate to high cost when examined in aggregate. There is no recommendation for or against use of these therapies (high-voltage galvanic, H-wave® Device Stimulation, iontophoresis, percutaneous electrical nerve stimulation, and sympathetic electrotherapy). There are alternate treatments that are effective.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Sympathetic Electrotherapy, Sympathetic Therapy, Sympathetic Electrical Stimulation Therapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 6 articles in PubMed, 36 in Scopus, 51 in CINAHL, 5 in Cochrane Library, 222 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms.

Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9. INJECTION THERAPIES

4.6.9.1. SUBACROMIAL KETOROLAC INJECTIONS

SUBACROMIAL KETOROLAC INJECTIONS FOR ROTATOR CUFF TENDINOPATHIES

Recommended

Subacromial ketalorac injections are moderately recommended for treatment of acute, subacute and chronic rotator cuff tendinopathies (including rotator cuff tendinoses, supraspinatus tendinitis, impingement syndrome, and subacromial bursitis).
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Moderate to severe pain from rotator cuff tendinopathies that control with NSAID(s) or acetaminophen is unsatisfactory (Adebajo et al., 1990, Petri et al., 1987, Blair et al., 1996, Akgun et al., 2004, Plafki et al., 2000).

Benefits

Improved or resolved pain. When combined with anesthetic (e.g., bupivacaine), these injections also have significant diagnostic benefit if evaluated a few minutes after the injection.

Harms

Negligible other than potential for an allergic reaction and/or risks typical of any injection.

Frequency/Dose/Duration

Trials have used ketorolac 30mg and 60mg. Most have used co-administration of an anesthetic medication, which is advised to help assist with both accuracy of placement (anesthesia) and diagnosis (post-anesthetic findings). A second injection after waiting at least 2 weeks may be reasonable if the response is suboptimal or the subacromial space was felt to have not been accessed, though it would be appropriate to consider a different technique or imaging. [868].

Indications for Discontinuation

If there has not been a response to a first injection, there is generally less indication for a second, particularly if there was anesthesia achieved with the injection, but no durable improvement in pain and function. If there is reason to believe the medication was not well placed (e.g., no post-injection anesthesia from the anesthetic) and/or if the underlying condition is so severe that one injection could not be expected to adequately treat the condition yet there is unlikely to be a complete rotator cuff tear, a second injection may be indicated. The (first or) second injection may be performed under ultrasound guidance for increased accuracy, if available, as there is some evidence suggesting superior placement with ultrasound guidance (Naredo et al., 2004, Chen et al., 2006, Ucuncu et al., 2009). Yet,

while ultrasound has been used in some studies (de Witte et al., 2013, Ekeberg et al., 2009, Plafki et al., 2000, Chavez-Lopez et al., 2009), there is little evidence to suggest outcomes superiority associated with using ultrasound for administration. Additional injections are also not generally indicated if the plan is for surgery (Puzzitiello et al., 2020).

Rationale

There are multiple moderate-quality trials that compared subacromial glucocorticosteroid which suggest equivalency with glucocorticosteroid injection without an adverse effects profile which for steroids may include worsening operative prognoses (Min et al., 2013, Goyal, 2022, Kim, 2021, Abolhasani, 2019, Siddique, 2021, Taheri, 2017, Akgun et al., 2004). Ketorolac injections are minimally invasive, have low adverse effects, are moderate costs and have evidence of efficacy and thus are recommended for treatment of rotator cuff tendinopathy.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Subacromial Glucocorticosteroid Injections; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 148 articles in PubMed, 2140 in Scopus, 65 in CINAHL, 63 in Cochrane Library, 159 in Google Scholar, and 37 from other sources†. We considered for inclusion 0from PubMed, 0 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 37 from other sources. Of the 40 articles considered for inclusion, 39 randomized trials and 1 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9.2. SUBACROMIAL GLUCOCORTICOSTEROID INJECTIONS

Several types of glucocorticoid injections have been used to treat patients with rotator cuff tendinopathies. Viscosupplementation, prolotherapy, growth hormone, and botulinum injections have also been utilized.

Glucocorticosteroids are widely used for treatment of rotator cuff-related disorders (298) (436) (437) (438) (439) (440) (441) (442). These injections deliver medication to the subacromial bursa, rotator cuff and surrounding tissue with minimal systemic effects (298) (436) (437) (443).

SUBACROMIAL GLUCOCORTICOSTEROID INJECTIONS FOR ACUTE, SUBACUTE, OR CHRONIC ROTATOR CUFF TENDINOPATHIES

Recommended

Subacromial glucocorticosteroid injections are moderately recommended for treatment of acute, subacute and chronic rotator cuff tendinopathies (including rotator cuff tendinoses, supraspinatus tendinitis, impingement syndrome, and subacromial bursitis).
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Moderate to severe pain from rotator cuff tendinopathies that control with NSAID(s) or acetaminophen is unsatisfactory (Adebajo et al., 1990, Petri et al., 1987, Blair et al., 1996, Akgun et al., 2004, Plafki et al., 2000). Generally, subacromial ketorolac is preferred due to lower adverse effects profile and data suggesting at least equivalency (see Subacromial Ketorolac Injections).

Caution is indicated among those who are thought to need surgery as injection has been associated with approximate doubling of the risk of infection and failure of rotator cuff repair (Puzzitiello et al., 2020).

Benefits

Improved or resolved pain

Harms

Steroid flare after an injection; rare infection. Potential for worse results if surgery is subsequently performed (Puzzitiello et al., 2020).

Frequency/Dose/Duration

Single injection should be scheduled and results evaluated, rather than scheduling a series of injections. A second injection after waiting at least 2 weeks may be reasonable if the response is suboptimal or the subacromial space was felt to have not been accessed, though it would be appropriate to consider a different technique or imaging (Naredo et al., 2004). Sometimes these injections are performed without glucocorticosteroid for diagnostic purposes (Mair et al., 2004). In most cases, glucocorticoid is added to local anesthetic for diagnostic confirmation and treatment with 1 injection. Multiple doses have been utilized with only one head-to-head comparative trial that suggested no differences (Chavez-Lopez et al., 2009). Medication doses used in the successful RCTs included triamcinolone 40mg to 80mg (Blair et al., 1996, Adebajo et al., 1990, Petri et al., 1987, White et al., 1986), betamethasone 6mg (Alvarez et al., 2005), and methylprednisolone 40mg to 80mg (Withrington et al., 1985, McInerney et al., 2003). It appears important that the negative trials tended to utilize smaller doses of steroid, such as triamcinolone 20mg (Ekeberg et al., 2009) or methylprednisolone 40mg (Vecchio et al., 1993). Nearly all combined the corticosteroid with variable doses of anesthetic, generally ranging from 2 to 10mL of lidocaine or bupivacaine (see evidence table). There are no head-to-head comparisons in quality studies of different medications to ascertain the optimum medication(s) or doses.

Indications for Discontinuation

A second glucocorticosteroid injection is not recommended if the first injection has resulted in significant reduction or resolution of symptoms. If there has not been a response to a first injection, there is generally less indication for a second, particularly if there was anesthesia achieved with the

injection, but no durable improvement in pain and function which may result in a consideration for surgery. If there is reason to believe the medication was not well placed (e.g., no post-injection anesthesia from the anesthetic) and/or if the underlying condition is so severe that one steroid bolus could not be expected to adequately treat the condition, a second injection may be indicated. The (first or) second injection may be performed under ultrasound guidance for increased accuracy, if available, as there is some evidence suggesting superior placement with ultrasound guidance (Naredo et al., 2004, Chen et al., 2006, Ucuncu et al., 2009). Yet, while ultrasound has been used in some studies (de Witte et al., 2013, Ekeberg et al., 2009, Plafki et al., 2000, Chavez-Lopez et al., 2009), there is little evidence to suggest outcomes superiority associated with using ultrasound for administration. Additional injections are also not generally indicated if the plan is for surgery (Puzzitiello et al., 2020).

Rationale

There are two high- and seven moderate-quality trials that compared subacromial glucocorticosteroid injection with saline of anesthetic placebos (Adebajo et al., 1990, Petri et al., 1987, Blair et al., 1996, Akgun et al., 2004, Plafki et al., 2000, Alvarez et al., 2005, Withrington et al., 1985, McInerney et al., 2003, Vecchio et al., 1993). Patients assessed included acute (Adebajo et al., 1990, Petri et al., 1987, McInerney et al., 2003), subacute (Adebajo et al., 1990, Petri et al., 1987, Blair et al., 1996, Withrington et al., 1985, Vecchio et al., 1993), and chronic rotator cuff tendinopathies (Petri et al., 1987, Blair et al., 1996, Akgun et al., 2004, Plafki et al., 2000, Alvarez et al., 2005, Withrington et al., 1985). All patient groups appeared to benefit without a clear pattern of response based on duration of symptoms with one exception. One trial of acute post-traumatic pain did not find benefit from these injections (McInerney et al., 2003), likely reflecting the excellent natural recovery from acute traumatic pain.

Most, but not all, studies showed benefits. It may not be coincidental that the high-quality study that was negative also utilized the lowest dose of 20mg triamcinolone in chronic shoulder pain patients (Ekeberg et al., 2009). Another of the negative studies also utilized a lower dose of steroid (Vecchio et al., 1993), while the last of the negative studies had the smallest sample size (Withrington et al., 1985). One trial was stopped due to the lack of efficacy of the placebo arm, while the corticosteroid arm was documenting benefits (Plafki et al., 2000). Thus, quality evidence documents efficacy of these injections. There also are two high-quality trials with injected NSAIDs, but they conflict regarding superiority (Karthikeyan, 2010, Min et al., 2013), resulting in no evidence-based recommendation on that approach and a need for further investigations. One moderate-quality study (Naredo et al., 2004) and one low-quality study (Chen et al., 2006) demonstrated increased efficacy, improved shoulder symptoms, of steroids injected under ultrasonic guidance. However, the studies discussed above that compared steroid injection with placebo did not use ultrasound guidance and still resulted in good outcomes.

A Cochrane review similarly concluded there is benefit compared with placebo for treatment of rotator cuff disease, but no significant benefit of injection compared with NSAID when pooling three studies (Buchbinder et al., 2004). Approaches utilized include anterior, anteromedial, lateral and posterior. A cadaveric study found no differences in accuracy for anteriolateral versus posterior approaches (Mathews et al., 2005).

Another utility of these injections is to predict surgical success. The impingement test with subacromial anesthetic injection was reported to result in 88% positive predictive value of surgical success vs. 60% in those negative, (Mair et al., 2004, Oh et al., 2010); thus, another rationale for injection includes prognosis.

These infections are not without risk as there is an approximate doubling of the risks of both infection and re-tear of a cuff repair if surgery is subsequently performed especially within 6 months of the injection (Puzzitiello et al., 2020).

Subacromial glucocorticosteroid injections are invasive, typically have a low risk of adverse effects and are moderately costly. They have the potential to briefly increase blood glucose, thus monitoring will be appropriate in some diabetic patients. They are effective; most comparative trials against NSAIDs have found these injections are superior (Adebajo et al., 1990, Petri et al., 1987); thus, these injections are recommended for management of these patients. Most should generally have failed prior treatment with NSAIDs and exercise. Patients who are anticipated to require rotator cuff repair within 6 months are generally poor candidates due to the potential to re-tear after repair (Puzzitiello et al., 2020).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Subacromial Glucocorticosteroid Injections; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 148 articles in PubMed, 2140 in Scopus, 65 in CINAHL, 63 in Cochrane Library, 159 in Google Scholar, and 37 from other sources†. We considered for inclusion 0from PubMed, 0 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 37 from other sources. Of the 40 articles considered for inclusion, 39 randomized trials and 1 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9.3. SUBACROMIAL EDTA MESOTHERAPY

Calcium disodium EDTA is a powerful chelator traditionally used to treat lead poisoning, although it also chelates other divalent cations. Subacromial EDTA injections and mesotherapy have been used to attempt to treat calcific tendinitis that has been unresponsive to other treatments (444).

SUBACROMIAL EDTA MESOTHERAPY INJECTIONS FOR SHOULDER CALCIFIC TENDINITIS

No Recommendation

There is no recommendation for or against the use of subacromial EDTA mesotherapy for treatment of shoulder calcific tendinitis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is one moderate-quality trial with 2 active interventions with placebo, comparing EDTA plus ultrasound versus placebo plus sham ultrasound suggesting reductions in all measures including pain, motion, Constant Murley scores, and calcifications (Cacchio, 2009). Thus, there is evidence suggesting potential efficacy of EDTA instilled for calcific tendinitis with duration of improvement documented at 1 year. EDTA has some risk of serious renal effects, although there was no increase in serum creatinine and BUN in this trial. The treatments are high cost, invasive, and require multiple treatments; there is no recommendation for this treatment as there is no evidence the results of the single trial were due to EDTA rather than ultrasound.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ethylenediaminetetraacetic acid, EDTA, Subacromial EDTA Mesotherapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 6 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 5 in Google Scholar, and 1 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 2 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9.4. VISCOSUPPLEMENTATION INJECTIONS

Viscosupplementation injections have been used to treat rotator cuff tendinopathies and impingement syndrome (311) (445) (446) (447) (448) (449) (450) (451) (452) (453) (454) (455).

SUBACROMIAL VISCOSUPPLEMENTATION INJECTIONS FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of subacromial viscosupplementation injections for the treatment of shoulder pain and rotator cuff tendinopathies (including rotator cuff tendinoses, supraspinatus tendinitis, impingement syndrome, and subacromial bursitis).
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One placebo-controlled trial reported modestly superior outcomes with viscosupplementation (Chou, 2010). Other trials reported faster resolution with glucocorticoid injection (Penning et al., 2014) or comparable efficacy (Kim et al., 2012). One trial reported improved results for adjunctive use of viscosupplementation to physical therapy exercises (Flores, 2017). There is one low-quality trial without a placebo-control suggesting few differences between hyaluronate injections and local modalities (Sengul et al., 2008). The literature is sparse and somewhat conflicting; thus, there is no recommendation for or against these injections for rotator cuff tendinopathies.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Viscosupplementation Injections, Hyaluronic Acid Injections; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 33 articles in PubMed, 854 in Scopus, 8 in CINAHL, 23 in Cochrane Library, 47 in Google Scholar, and 1 from other sources†. We considered for inclusion 6 from PubMed, 3 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 13 articles considered for inclusion, 5 randomized trials and 7 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9.5. PLATELET-RICH PLASMA INJECTIONS

PLATELET-RICH PLASMA INJECTIONS FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN OR ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for or against subacromial platelet-rich plasma (PRP) injections for the treatment of shoulder pain and rotator cuff tendinopathies (including rotator cuff tendinoses, supraspinatus tendinitis, impingement syndrome, and subacromial bursitis).

[58.33% panel agreement on No Recommendation. 8.33% agreed with Recommended and 33.33% agreed with Not Recommended.]
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

Studies substantially conflict regarding efficacy of PRP injections for the shoulder. Systematic reviews and metanalyses have also reported conflicting results, although most report a lack of short- to intermediate-term benefits (Hamid, 2021, Lin, 2020, Hurley et al., 2019, Zhu, 2020, Li, 2022); if there are benefits, the average magnitude is not large. There also appears to be no benefit compared with

glucocorticoid injection (Adra, 2023) or exercise therapy (Hurley et al., 2019). Results assessing objective measures of improvement are weak. There are increasing numbers of studies suggesting a potential for reduced retear rates after surgical repairs associated with PRP (Cavendish et al., 2020). One trial had worse baseline data in the PRP group, likely biasing in favor of more change in that group, and nevertheless concluded there was comparable efficacy with steroid injection (Dadgostar, 2021).

Most studies reported a lack of additive benefit of PRP injections for surgical repairs (Snow et al., 2019, Malavolta et al., 2014, Malavolta et al., 2018, Ruiz-Moneo et al., 2013, Wang et al., 2015, Ebert et al., 2017, Carr et al., 2015, Verhaegen et al., 2016), while a few trials reported efficacy, especially for re-tear rates among those with larger tears (Pandey et al., 2016) and another among smaller tears (Cai, 2018). Another trial with PRP in a fibrin matrix found lack of efficacy (Walsh et al., 2018, Barber, 2016). Treatment of tendinitis and partial thickness tears with PRP suggested a lack of efficacy at 6- and 12-months (Kesikburun et al., 2013, Shams et al., 2016). A RCT reported platelet-rich fibrin did not result in superior rotator cuff repair results (Lädermann et al., 2016). Thus, as most studies suggest a lack of efficacy, PRP injections are not recommended for treatment of shoulder pain and rotator cuff tendinopathies.

Thus, as studies conflict regarding efficacy, there is no recommendation regarding PRP injections for treatment of shoulder pain and rotator cuff tendinopathies. The expert panel vote on this recommendation was split as noted above.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Platelet-rich Plasma Injections; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 200 articles in PubMed, 1532 in Scopus, 38760 in CINAHL, 94 in Cochrane Library, 427 in Google Scholar, and 3 from other sources†. We considered for inclusion 28 from PubMed, 5 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 2 from Google Scholar, and 3 from other sources. Of the 40 articles considered for inclusion, 21 randomized trials and 13 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9.6. NEEDLING AND BURSOSCOPY

Needling of calcium deposits and bursoscopy for removal of calcific tendinitis has been performed (456) (457) (458) (459). Needling is a precise procedure used to treat calcific deposits. It makes small needle sized holes in the tissue overlying the calcific deposit. Needling has been studied in conjunction with shockwave therapy (457), and involves “several tens of intra-calcic drillings in the axis of

calcification" needling of the calcific deposits (459). Bursoscopy is arthroscopic removal/excision of the bursa.

Dry needling has been used for the treatment of calcific rotator cuff tendinopathies (460) (461) (462) (463) (464) (465) (466) (467) (468). Barbotage has also been used, which couples needling of calcific deposits with lavage while generally using ultrasound for visualization (469). Dry needling has also been used for treatment of myofascial pain (see Trigger Points and Myofascial Pain).

ULTRASOUND-GUIDED NEEDLING WITH OR WITHOUT EXTRACORPOREAL SHOCKWAVE THERAPY FOR CALCIFIC ROTATOR CUFF TENDINITIS

Recommended

Ultrasound-guided needling coupled with lavage with ultrasound visualization is recommended for treatment of calcific rotator cuff tendinitis.
Strength of evidence Recommended, Evidence (C)
Level of confidence Moderate

Indications

Moderate to severe calcific rotator cuff tendinitis

Benefits

Improved pain and function at 1 year compared to steroid injection (de Witte et al., 2013), although the benefits disappeared by 5 years (de Witte et al., 2017).

Harms

Infection, adhesive capsulitis, worsened pain

Frequency/Dose/Duration

One trial suggested post-procedure glucocorticosteroid injection with methylprednisolone acetate 40mg improved results (Darrieutort-Laffite et al., 2019). Another trial suggested modest superiority of triamcinolone acetonide vs. methylprednisolone acetate, apparently using 40-mg doses for both, although the dose administered is a little unclear (Battaglia et al., 2017).

Rationale

Dry needling has been performed for trigger points (see Trigger Points/Myofascial Pain). One RCT suggested barbotage with ultrasound for visualization is modestly effective for calcium deposits and function at one year but the differences disappeared by 5 years of follow-up (de Witte et al., 2013, de Witte et al., 2017). Another moderate-quality trial suggested adding needling is effective when used as an adjunct with shockwave therapy (Krasny et al., 2005). Needling a calcific deposit is minimally invasive and less costly than surgery with minimal adverse effects. One quality study suggested barbotage is more effective over one year for treatment of calcific tendinitis; thus, it is selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Dry Needling; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 2325 in Scopus, 56 in CINAHL, 0 in Cochrane Library, 131 in Google Scholar, and 3 from other sources†. We considered for inclusion 1 from PubMed, 1 from Scopus, 7 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 3 from other sources. Of the 14 articles considered for inclusion 12 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

BURSOSCOPY FOR CALCIFIC ROTATOR CUFF TENDINITIS

Recommended

Bursoscopy (arthroscopic removal/excision of bursa) is recommended for treatment of calcific rotator cuff tendinitis.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Gartner Type I or II calcium deposits of calcific tendinitis (Maugars et al., 2009). Patients should generally have failed prior treatment with NSAIDs, exercise, and injection(s) (Maugars et al., 2009).

Benefits

Removal of calcium deposits and improved pain

Harms

Adhesive capsulitis, infection

Frequency/Dose/Duration

Treatment in the quality trial is a single treatment. It may be reasonable to attempt a second treatment if the initial treatment was partially, but inadequately effective.

Rationale

There is one moderate-quality trial suggesting needling or bursoscopy is superior to a non-interventional control (Maugars et al., 2009). Addition of subacromial decompression to bursectomy

has been reportedly not effective (Clement, 2015). Bursoscopy and removal of calcium deposits has been shown to be superior to a non-interventional control and thus is selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Bursoscopy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 2 articles in PubMed, 34 in Scopus, 1 in CINAHL, 1 in Cochrane Library, 38 in Google Scholar, and 2 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 2 articles considered for inclusion, 1 randomized trials and 0 systematic reviews fit the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9.7. PROLOTHERAPY

Prolotherapy injection has been used to treat rotator cuff tendinopathies (470) (471) (472) (473) (474) (475) (476) (477) (478).

PROLOTHERAPY FOR ROTATOR CUFF TENDINOPATHY

Not Recommended

Prolotherapy is not recommended for treatment of rotator cuff tendinopathies.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Low

Rationale

The highest quality placebo-controlled trial found prolotherapy was ineffective for bursal injections and also reported evidence suggesting increased tendon stiffness in the prolotherapy group (Chang et al., 2021). Two other placebo-controlled RCTs had baseline differences making the results difficult to interpret (Bertrand et al., 2016, Lin et al., 2018). Two comparative trials comparing prolotherapy with glucocorticoid injection conflict regarding efficacy, and one of them reported comparable (in)efficacy at 6 months (Clement, 2015, Cole et al., 2018, Amanollahi et al., 2019). Because the sole placebo-controlled trial suggests both lack of benefit and potential adverse effects, prolotherapy is not recommended for rotator cuff tendinopathies.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Prolotherapy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 21 articles in PubMed, 913 in Scopus, 9 in CINAHL, 23 in Cochrane Library, 115 in Google Scholar, and 0 from other sources†. We considered for inclusion 7 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 9 articles considered for inclusion, 8 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9.8. LIPOSOMAL BUPIVACAINE

Liposomal bupivacaine has been used for the treatment of rotator cuff tendinopathies (479) (480) (481) (482) (483) (483) (484) (395) (485) (486) (487) (488).

LIPOSOMAL BUPIVACAINE FOR ROTATOR CUFF TENDINOPATHIES

No Recommendation

There is no recommendation for liposomal bupivacaine.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

A placebo-controlled trial found lack of efficacy for the injection of subacromial liposomal bupivacaine injected at the end of the arthroscopic procedure (Verdecchia et al., 2020). Another placebo-controlled RCT found efficacy for injection near the superior part of the brachial plexus at least 1 hour ahead of the procedure (Patel et al., 2020). Interscalene blocks have been reportedly superior to liposomal bupivacaine (Abildgaard et al., 2017, Namdari et al., 2017, Namdari, 2018), while another trial found them to be equivalent (Sabesan et al., 2017). One trial found liposomal bupivacaine substantially effective (Sethi et al., 2019). As there are multiple RCTs and they substantially conflict regarding efficacy, there is no recommendation regarding liposomal bupivacaine.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Liposomal Bupivacaine; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective

studies. We found and reviewed 5 articles in PubMed, 176 in Scopus, 3 in CINAHL, 15 in Cochrane Library, 448 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 11 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 15 articles considered for inclusion, 9 randomized trials and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9.9. STEM CELL INJECTIONS

Stem cell injections have been used to treat rotator cuff tendinopathies (489) (490) (491) (492) (493) (494) (495) (496) (497) (498) (499).

STEM CELL INJECTIONS FOR ROTATOR CUFF TENDINOPATHY

No Recommendation

There is no recommendation for stem cells for treatment of rotator cuff tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no placebo-controlled trials. The available trials have quite small sample sizes and are pilot studies. Thus, larger studies are needed for an evidence-based recommendation and there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Stem Cells; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 47 articles in PubMed, 5943 in Scopus, 32 in CINAHL, 0 in Cochrane Library, 211 in Google Scholar, and 0 from other sources†. We considered for inclusion 5 from PubMed, 2 from Scopus, 3 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 11 articles considered for inclusion, 2 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9.10. TRIGGER POINT INJECTIONS

Trigger point injections have been used to treat rotator cuff tendinopathies with trigger points (354) (500) (501) (502) (503) (504) (505) (506) (507) (508) (509) (105) (106) (59). See Trigger Points and Myofascial Pain

4.6.9.11. GROWTH HORMONE

Growth hormone has been used for the treatment of rotator cuff tendinopathies (510).

GROWTH HORMONE FOR ROTATOR CUFF TENDINOPATHY

Not Recommended

Growth hormone is not recommended for treatment of rotator cuff tendinopathies.
Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Rationale

One RCT has evaluated growth hormone to improve post-operative healing, finding lack of efficacy (Oh et al., 2018). Thus, growth hormone is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Growth Hormone, Somatotropin, Human Growth Hormone; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 290 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 157 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9.12. GRANULOCYTE COLONY STIMULATING FACTOR (GCSF)

Granulocyte-colony stimulating factor (GCSF), a type of cytokines receptor antagonist, has been shown to induce bone marrow mobilization to increase circulating stem cell concentration. No quality evidence was found for the treatment of rotator cuff tendinopathies (511) (512).

GRANULOCYTE COLONY-STIMULATING FACTOR (GCSF) FOR ROTATOR CUFF TENDINOPATHY

No Recommendation

There is no recommendation for granulocyte colony-stimulating factor (GCSF) for treatment of rotator cuff tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy and thus there is no recommendation for GCSF.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Growth Colony Stimulating Factor; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 218 in Scopus, 41 in CINAHL, 0 in Cochrane Library, 25 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.9.13. ATELOCOLLAGEN

Atelocollagen has been used in the treatment of rotator cuff tendinopathies (513) (514) (515).

ATELOCOLLAGEN FOR ROTATOR CUFF TENDINOPATHY

No Recommendation

There is no recommendation for atelocollagen for treatment of rotator cuff tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is one RCT with relatively modestly sized groups, although some data suggest potential efficacy (Kim et al., 2020). The study needs replication and thus there is no recommendation for atelocollagen.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Atelocollagen; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 1 article in PubMed, 15 in Scopus, 3 in CINAHL, 0 in Cochrane Library, 63 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 1 from other sources. Of the 4 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.10. SURGICAL CONSIDERATIONS

4.6.10.1. SURGICAL REPAIR OF ROTATOR TEARS

Surgery has been used to treat rotator cuff tears. Yet, many individuals with rotator cuff tears have minimal or no functional deficits; therefore, careful evaluation of the patient's functional status is required.

ROTATOR CUFF REPAIR FOR SMALL, MEDIUM, OR LARGE TEARS

Recommended

Rotator cuff repair is moderately recommended for selective treatment of small, medium, or large tears (<5 cm).
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

All of the following: 1) shoulder joint pain; 2) reduced ROM of the shoulder or impaired function; 3) imaging findings by MRI, MR arthrography, or ultrasound of rotator cuff tear. Patient must agree to participate fully in post-operative active rehabilitation and understand there is a long recovery time. Worse outcomes are predicated by older age, worse health status, smoking and fatty tendon degeneration (Khazzam, 2020, Abtahi, 2015, Fan, 2022).

Pre-operative physical therapy and injection(s) are option(s) (but not a pre-operative requirement)

especially for articular-sided tears, as many patients sufficiently recover without surgery (Kukkonen et al., 2015, Moosmayer et al., 2014). However, for small tears, an attempt at rehabilitation for a few weeks is often successful and is generally recommended for most patients.

Benefits

Improved pain and function

Harms

Potential for lack of significant pain and/or function improvement, surgical complications, lack of healing, adhesive capsulitis.

Rationale

There are many quality studies of surgery for RC tear, although there are no sham-controlled trials. There are a few quality studies comparing surgical repair of rotator cuff tears with non-operative treatment (see evidence table) that suggest that while exercises and physical therapy may be a reasonable option for initially presenting rotator cuff tear patients (Kukkonen et al., 2015, Heerspink et al., 2015, Moosmayer et al., 2014, MacDermid et al., 2006, Ejnisman et al., 2004), there is important evidence of superiority of surgery for small to medium tears over 5-10 year durations (Moosmayer et al., 2014, Moosmayer et al., 2019).

While surgery tends to produce superior outcomes over 1 to 10 years (Moosmayer et al., 2014, Moosmayer et al., 2010, Moosmayer et al., 2019) and there are no quality data to the contrary, non-operative treatment often is successful (Moosmayer et al., 2014, Moosmayer et al., 2010, Kukkonen et al., 2015). Thus, although many quality studies necessitated non-operative treatment prior to surgery (see evidence table) (Mohtadi et al., 2014, Spangehl et al., 2002), with some for at least 3 months (Mohtadi et al., 2014, Franceschi, 2007, Franceschi et al., 2008, Iannotti et al., 2006), one for up to 33 months prior to surgery (these trials are typically reported from countries with waiting lists for procedures) (Ko et al., 2008), and some studies have required failure of a glucocorticosteroid injection (Franceschi et al., 2007, Dorrestijn et al., 2007), there should be no requirement for failure of exercises, injection(s), and physical therapy as a pre-operative requirement. Surgical cuff repair is believed to be a superior option among patients for whom occupational shoulder exposures and demands are greater, although quality data that address this issue are not available.

Rotator cuff repair has evolved from open to mini-open to all arthroscopic techniques. Currently, arthroscopic techniques are evolving with the advent of new technology and instrumentation (Ogilvie-Harris et al., 1993, Neviaser, 1989, Neer, 1972, Rockwood et al., 1993, Ellman et al., 1993, Baker et al., 1995, Sauerbrey et al., 2005, Verma et al., 2006, Skoff, 1995, Youm et al., 2005, Seida JC, 2010). Rates of arthroscopic anterior acromioplasty have increased 5.8-fold from 1980 to 2005 (Yu et al., 2010). There are quality studies available on short- and long-term comparisons between arthroscopic and open or mini-open repairs (Carr et al., 2017, Spangehl et al., 2002, Nho et al., 2007, Morse et al., 2008, van der Zwaal et al., 2013, Cho, 2012). Arthroscopic repair is associated with lower complication rates, infection, and deltoid dehiscence. There is high-quality evidence showing no long-term differences associated with arthroscopic repair and mini-open compared to open repair (Carr et al., 2017, Mohtadi et al., 2005, Spangehl et al., 2002, van der Zwaal et al., 2013, Cho, 2012), although evidence suggests a modest short-term advantage of arthroscopic mini-open repair versus open repair of rotator cuff tears while infection rates are higher with mini-open than arthroscopic repairs (Mohtadi et al., 2014).

Many individuals with rotator cuff tears have minimal or no functional deficits, (Moosmayer et al., 2005, Needell et al., 1996, Sher et al., 1995, Schibany et al., 2004); thus, careful evaluation of the patient's functional status is required. Many patients function normally with rotator cuff tears, while others have incapacitating problems that may require physical therapy (Moosmayer et al., 2010, Moosmayer et al., 2014, Ainsworth et al., 2007) and/or attempts at surgical repair or debridement. Rotator cuff tears have the potential to progress (Matava et al., 2005, Yamaguchi et al., 2006). For patients with tears accompanied by functional deficits, rotator cuff repairs appear to speed recovery. There also are reports of improved overall health status after rotator cuff surgery (McKee et al., 2000). It is unclear whether surgical repair of the rotator cuff changes the risk of future surgery. There are different rating systems for grading rotator cuff tears including consideration of the size of the tear, the extension of tear retraction, and the quality of the rotator cuff muscles (DeOrio et al., 1984, Patte, 1990, Goutallier et al., 1994)(Bateman, 1963). Repairs of larger tears have increased rate of healing failure which correlates with outcomes (Iannotti et al., 2006, Milano et al., 2007, Wilson et al., 2002, Habernek et al., 1999, Warner, 2001).

There are many purported and documented risk factors for poorer surgical outcomes. These most common risk factors include low-volume surgical practice (physician performs less than 6 rotator cuff repairs per year) (Sherman et al., 2008), age (older patients) (Sherman et al., 2008, Ogilvie-Harris et al., 1990, Boehm et al., 2005, Watson, 1985), female sex (Boehm et al., 2005, Lindh et al., 1993), larger rotator cuff tears (Iannotti et al., 2006, Milano et al., 2007, Wilson et al., 2002, Habernek et al., 1999, Warner, 2001, Bartolozzi et al., 1994, Rokito et al., 1996), retraction (Milano et al., 2007), concomitant subscapularis tears (Milano et al., 2007), fatty tendon degeneration (Milano et al., 2007, Costouros et al., 2007), diabetes, smoking (Mallon et al., 2004), overweight or obesity, weakness of shoulder (strength of abduction and external rotation), pre-operative activity level, (Iannotti et al., 2006, Ellman et al., 1986), preoperative stiffness (Namdari et al., 2010), abnormal mental status, involvement in litigation or workers' compensation (Spangehl et al., 2002, Ogilvie-Harris et al., 1990, Kempf et al., 1999, Misamore et al., 1995) or sick leave (Brox et al., 1999), regular "pain medication use" (Brox et al., 1999), excessive post-operative hyperalgesic crises (Kempf et al., 1999), non-compliance with rehabilitation programs, and otherwise unhealthy individuals (Sherman et al., 2008). One report found shorter interval between symptom onset and massive rotator cuff repair to be negatively correlated with outcomes (Gerber et al., 2000). Post-operative shoulder stiffness was found to be best predicted by pre-operative limitation in ROM (Namdari et al., 2010), especially the "hand behind the back" maneuver (Trenerry et al., 2005). Work with the "hand above the level of the head" trended towards significance in one possibly underpowered study (Brox et al., 1999). Studies suggest delayed treatment results in worse outcomes among patients with rotator cuff tears (Habernek et al., 1999, Fu, 2020, Duncan, 2015), but no quality study has addressed that question.

If surgery is a consideration, counseling regarding likely outcomes, risks, and benefits, and especially expectations, is important. Ideally, this education begins with the referring physician who may note that post-operative physical or occupational therapy exercises are essential in comparison to non-operative treatment for good clinical results. Compliance with these exercises might be difficult for some rotator cuff repair patients. The decision as to which type of rotator cuff repair procedure to perform – arthroscopic, open, or mini-open repair – should be left to the surgeon and patient until quality evidence demonstrating procedural superiority becomes available to provide evidence-based guidance. Achievement of a plateau in improvement and assessment for final results after surgical repair of a rotator cuff tear has been found to require 1 year (Van Linthoudt et al., 2003). Revision

surgeries are particularly challenging, usually result in inferior results compared with primary repairs, and should be undertaken with a good deal of caution (Djurasovic et al., 2001).

Re-tear rates vary widely, depending on numerous factors especially the size of the tear and the quality of the tendon and rotator cuff muscles. The re-tear rate for a single row arthroscopic repair has been estimated at 40%, but varies considerably depending on the size of original tear (Burks, 2009, Bishop et al., 2006, Fealy et al., 2006, Gladstone et al., 2007, Liu et al., 1994). There is little quality evidence for superiority of one type of repair over another (e.g., single stitch versus double stitch) (Malavolta et al., 2014, Randelli et al., 2017, Franceschi et al., 2007, Burks, 2009, Grasso et al., 2009, Lapner et al., 2012, Carbonel et al., 2012, Ma et al., 2012, Koh et al., 2011) or No. 3 Ethibond Mason-Allen sutures versus 1.0 mm polydioxanone cord with modified Kessler sutures (Boehm et al., 2005). A meta-analysis and systematic review found double-row repair to have lower re-tear rates and greater internal rotation ROM but showed no other differences compared to single-row repair (Xu et al., 2014, Saridakis et al., 2010). One trial suggested a markedly lower re-tear rate with suture-spanning augmentation technique of single-row compared with standard single row repair (Ma et al., 2019). There is one moderate-quality study that has suggested a modified mattress-locking stitch is modestly superior to simple stitches; however, the study has considerable weaknesses that raise questions about the validity of the conclusions (Ko et al., 2008). One study of arthroscopic repairs with long-term follow-up of up to 14 years looked at staple fixation repairs and side-to-side suture and anchor repairs; both kinds of repairs appear to document surgical success, although larger tears appear associated with lower success rates (Wilson et al., 2002). Almost all repairs require reattachment of tendon to bone. Isolated side-to-side repair or margin convergence means that there is an incomplete repair as is usually present in cases of chronic massive tears. Tendon to bone repair has been suggested to be modestly better than side-to-side repair in one moderate-quality study (Bigoni et al., 2009). Re-tears do not necessarily equate to pain and functional loss, just as some people have primary asymptomatic rotator cuff tears. Research suggests outcome scores are better with healed rotator cuff than unhealed rotator cuff tears

Most quality evidence included patients with small to moderate tears. Patients who are candidates for surgery generally have pain and impaired function. There are no quality studies suggesting better or worse results for earlier or delayed surgery (see evidence table), and current evidence does not support a need to rush surgical decisions. Until quality evidence becomes available to provide evidence-based guidance, the decision as to which surgical procedure to perform should be left to the surgeon and patient as there appear to be only modest short-term improvements for arthroscopic rotator cuff repair over open rotator cuff repairs (Mohtadi et al., 2014) or for impingement syndrome, including trends towards shorter sick leave in one study (mean 10 versus 5.7 weeks) (Husby et al., 2003) but not another (Rubenthaler et al., 2003). Early surgery should generally be considered in cases of acute traumatic tears, especially larger tears in healthy, active individuals; however, one trial has suggested no benefit of earlier surgery (Kim et al., 2018). Surgery is invasive, involves prolonged recovery (many months), has adverse effects, and is costly. However, benefits appear to outweigh risks for patients with significant pain, impaired function, and a documented tear; thus, surgery is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Rotator Cuff Repair; arthroscopy, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial,

controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 980 articles in PubMed, 5738 in Scopus, 29247 in CINAHL, 34 in Cochrane Library, 2550 in Google Scholar, and 12 from other sources†. We considered for inclusion 10 from PubMed, 0 from Scopus, 4 from CINAHL, 3 from Cochrane Library, 0 from Google Scholar, and12 from other sources. Of the 24 articles considered for inclusion, 21 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

REVERSE SHOULDER ARTHROPLASTY FOR MASSIVE ROTATOR CUFF TEARS

Sometimes Recommended

Reverse shoulder arthroplasty is recommended for treatment of select large to massive cuff tears that are otherwise unrepairable.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

All of the following: 1) shoulder joint pain; 2) reduced range of motion of the shoulder and/or impaired function; 3) imaging findings by MRI, MR arthrography, or ultrasound of large to massive rotator cuff tear; and 4) generally have either an unrepairable tear or have failed surgical repair. Generally, younger healthier patients are better candidates for reverse shoulder arthroplasty.

Benefits

Potential to improve the pain and functional decrements, although reverse shoulder arthroplasty may not result in complete recovery of function for repair of massive tears.

Harms

Potential for lack of significant pain and/or function improvement, surgical complications, lack of healing, adhesive capsulitis.

Rationale

There are no quality studies comparing reverse shoulder arthroplasty with non-surgical management of massive rotator cuff tears or to other surgical procedures. Reverse shoulder arthroplasty is generally reserved and selectively recommended for highly select cases of large to massive cuff tears that are either unrepairable or have failed repair, yet there are significant functional deficits that are felt likely or potentially able to be addressed through reverse shoulder arthroplasty. Additionally, a quality post-op rehabilitation program is essential to effect better outcomes.

Evidence

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.10.2. ACUTE MASSIVE TEARS

ROTATOR CUFF REPAIR FOR ACUTE MASSIVE TEARS

Sometimes Recommended

Rotator cuff repair is selectively recommended for treatment of acute massive tears (>5 cm).
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

All of the following: 1) shoulder joint pain; 2) reduced range of motion of the shoulder or impaired function; 3) imaging findings by MRI, MR arthrography, or ultrasound of massive rotator cuff tear. Generally, younger, healthier patients are better candidates for surgery for massive tears.

Benefits

Potential to improve the pain and functional decrements, although surgery often does not result in complete recovery for repair of massive tears.

Harms

Potential for lack of significant pain and/or function improvement, surgical complications, lack of healing, adhesive capsulitis.

Rationale

Repair of massive rotator cuff tears is technically more difficult and has a worse prognosis (Galatz, 2004, Matthews et al., 2006). There are no quality studies comparing these repairs with non-operative treatment for massive tears, although many surgeons will recommend an initial trial of non-operative care for elderly patients with massive rotator cuff tears. Some chronic massive tears can be repaired and some can also undergo successful partial repair, although this does not apply for most patients. Most repairs are tendon to bone. One quality study solely addressed surgical repair of massive rotator cuff tears (Iannotti et al., 2006). Surgical repairs have utilized multiple different techniques, with a preference for primary repair when the patient's tissue may be approximated. A study of 27 shoulders found primary rotator cuff repair was often infeasible when the length was greater than 4cm, the width was greater than 4cm, the supraspinatus muscle was thin at the superior glenoid margin, and the signal intensity was high (Sugihara et al., 2003).

Most quality evidence included patients with small to moderate tears, where there is some evidence that surgical outcomes are superior to non-surgical treatment at 5-10 years, although those trials did

not include patients with massive tears (Moosmayer et al., 2019, Moosmayer et al., 2014). Patients who are candidates for surgery generally have pain and impaired function. There are no quality studies suggesting better or worse results for earlier or delayed surgery for massive tears (see evidence table), and current evidence does not support a need to rush surgical decisions (Moosmayer et al., 2019, Moosmayer et al., 2014). Until quality evidence becomes available to provide evidence-based guidance, the decision as to which surgical procedure to perform should be left to the surgeon and patient as there appear to be only modest short-term improvements for arthroscopic rotator cuff repair over open rotator cuff repairs (Mohtadi et al., 2014) or for impingement syndrome, including trends towards shorter sick leave in one study (mean 10 versus 5.7 weeks) (Husby et al., 2003) but not all (Rubenthaler et al., 2003).

Early surgery should be considered in cases of acute traumatic tears, especially larger tears in healthy, active individuals. Surgery is invasive, involves prolonged recovery (many months), has adverse effects, and is costly. However, benefits appear to outweigh risks for patients with significant pain, impaired function and a documented massive tear, and surgery is thus selectively recommended, particularly for younger healthier patients.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Rotator Cuff Repair; arthroscopy, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 980 articles in PubMed, 5738 in Scopus, 29247 in CINAHL, 34 in Cochrane Library, 2550 in Google Scholar, and 40 from other sources†. We considered for inclusion 10 from PubMed, 0 from Scopus, 4 from CINAHL, 3 from Cochrane Library, 0 from Google Scholar, and 40 from other sources. Of the 57 articles considered for inclusion, 49 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.10.3. CHRONIC MASSIVE TEARS

ROTATOR CUFF REPAIR FOR CHRONIC MASSIVE TEARS

Not Recommended

Rotator cuff repair is not generally recommended for treatment of chronic massive tears (>5 cm).
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Low

Rationale

Surgery for massive tears is less successful than for smaller and moderate-sized tears. Repair of massive rotator cuff tears is technically more difficult and has a worse prognosis (Matthews et al., 2006, Galatz, 2004). Subacromial balloon spacers are being used, however, there are insufficient RCTs and confounding with simultaneous bicipital tenotomy is present in the available literature (Metcalfe, 2022). There are no quality studies comparing these repairs with non-operative treatment, although many surgeons will recommend an initial trial of non-operative care for elderly patients with massive rotator cuff tears. Some chronic massive tears can be repaired and some can also undergo successful partial repair, although this does not apply for most patients. Some indicators suggesting the potential for successful repair include otherwise good health and function with a lack of fatty infiltration. Most repairs are tendon to bone. One quality study solely addressed surgical repair of massive rotator cuff tears (Iannotti et al., 2006). Surgical repairs have utilized multiple different techniques, with a preference for primary repair when the patient's tissue may be approximated. A study of 27 shoulders found primary rotator cuff repair was often infeasible when the length was greater than 4cm, the width was greater than 4cm, the supraspinatus muscle was thin at the superior glenoid margin, and the signal intensity was high (Sugihara et al., 2003).

Surgery also appears more successful for acute rather than chronic tears. Also, while surgery tends to produce modestly superior outcomes over 1 to 5 years (Moosmayer et al., 2014), non-operative treatment is often successful (Moosmayer et al., 2014, Kukkonen et al., 2015). Thus, physical therapy is a reasonable option for many patients (Moosmayer et al., 2014, Kukkonen et al., 2015).

Surgery is invasive, involves prolonged recovery (many months), has adverse effects, and is costly. Benefits appear to generally be outweighed by risks for patients with chronic massive tears and thus is not recommended. Instead, rehabilitation is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Rotator Cuff Repair; arthroscopy, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 980 articles in PubMed, 5738 in Scopus, 29247 in CINAHL, 34 in Cochrane Library, 2550 in Google Scholar, and 40 from other sources†. We considered for inclusion 10 from PubMed, 0 from Scopus, 4 from CINAHL, 3 from Cochrane Library, 0 from Google Scholar, and 40 from other sources. Of the 57 articles considered for inclusion, 49 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.10.4. XENOGRAFTING

ROTATOR CUFF REPAIR FOR MASSIVE TEARS USING PORCINE XENOGRAFT MATERIAL

Not Recommended

Porcine small intestine submucosa graft for surgical repair is not recommended for treatment of large or massive tears that are otherwise unrepairable.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Low

Rationale

When primary closure with approximation of the tendon tissue is not possible, utilization of graft material, including the patient's bicipital tendon (Cho, 2009) or subscapularis (Tanaka et al., 2006), is sometimes utilized (i.e., autografts). Additional materials interposed include porcine dermal xenograft (Badhe, 2008) and porcine small intestinal submucosa (Sclamberg et al., 2004). Neither of the latter appeared to fare well, and the sole quality trial that included only patients with massive tears failed to find improvements with a porcine small intestinal submucosa graft (Iannotti et al., 2006); thus, is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Rotator Cuff Repair; arthroscopy, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 980 articles in PubMed, 5738 in Scopus, 29247 in CINAHL, 34 in Cochrane Library, 2550 in Google Scholar, and 40 from other sources†. We considered for inclusion 10 from PubMed, 0 from Scopus, 4 from CINAHL, 3 from Cochrane Library, 0 from Google Scholar, and 40 from other sources. Of the 57 articles considered for inclusion, 49 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.10.5. TISSUE AUGMENTATION

ROTATOR CUFF REPAIR FOR MASSIVE TEARS USING TISSUE AUGMENTATION

No Recommendation

There is no recommendation for or against tissue augmentation to surgically repair large or massive tears that are otherwise unrepairable.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

Repair of massive rotator cuff tears is technically more difficult and has a worse prognosis (Matthews et al., 2006, Galatz, 2004). There are no quality studies comparing these repairs with non-operative treatment, although many surgeons will recommend an initial trial of non-operative care for elderly patients with massive rotator cuff tears. Some chronic massive tears can be repaired and some can also undergo successful partial repair, although this does not apply for most patients. Most repairs are tendon to bone. One quality study solely addressed surgical repair of massive rotator cuff tears (Iannotti et al., 2006). Surgical repairs have utilized multiple different techniques, with a preference for primary repair when the patient's tissue may be approximated. A study of 27 shoulders found primary rotator cuff repair was often infeasible when the length was greater than 4cm, the width was greater than 4cm, the supraspinatus muscle was thin at the superior glenoid margin, and the signal intensity was high (Sugihara et al., 2003).

Techniques include open repair (Worland et al., 1999), arthroscopic, arthroplasty-related procedures (Boileau et al., 2008), as well as tissue transfers (latissimus dorsi) (Costouros et al., 2007), tissue grafting (autograft, allograft, xenograft) (Tsiridis et al., 2008), and combination procedures (Boileau et al., 2008). Two studies suggest no meaningful differences between arthroscopic and mini-open repairs (Kasten et al., 2011, Cho, 2012). Tissue grafts are intended to augment a repair, not fill a tissue defect. There is insufficient evidence currently to recommend a particular type of graft. Cases of margin convergence may be amenable to a primary closure, if the tendon edges can be approximated without undue tension on the patient's remaining rotator cuff. A few of these repairs were included in the available quality literature (see evidence table), but did not present stratified analyses specific to massive rotator cuff tears. Even so, there is some limited evidence suggesting repair is superior to debridement with considerably better results in the surgical repaired group (Melillo, 1997); thus, there is limited evidence to recommend attempted repair of massive rotator cuff tears (Iannotti et al., 2006).

When primary closure with approximation of the tendon tissue is not possible, utilization of graft material, including the patient's bicipital tendon (Cho, 2009) or subscapularis (Tanaka et al., 2006), is sometimes utilized (i.e., autografts). Additional materials interposed include porcine dermal xenograft (Badhe, 2008) and porcine small intestinal submucosa (Sclamberg et al., 2004). Neither of the latter appeared to fare well, and the sole quality trial that included only patients with massive tears failed to find improvements with a porcine small intestinal submucosa graft (Iannotti et al., 2006); thus, is not recommended.

Hemiarthroplasty has also been used to treat select patients with massive tears (see Arthroplasty), but there are no quality studies of hemiarthroplasty for treatment of massive rotator cuff tears (de Cupis et al., 2008, Boileau et al., 2005). Reverse total shoulder replacement is currently being used more often with more predictable results. It also is used to treat selected patients with unrepairable massive rotator cuff tears (Matsen et al., 2007).

Case series of patients who have reportedly undergone debridement and subacromial decompression as part of treatment of full-thickness, irreparable rotator cuff tears have found some decrease in pain and improved ROM, although post-operative strength was reduced (Gartsman et al., 1997). A review suggested debridement alone was insufficient for treatment for massive rotator cuff tears (Melillo, 1997). A case series found biceps tenotomy did not add benefits over debridement of irreparable massive rotator cuff tears (Klinger et al., 2005). Reverse total shoulder has been used for shoulder osteoarthritis associated massive cuff ruptures (de Cupis et al., 2008, Boileau et al., 2005, Young et al., 2009). In a case series, the reverse total shoulder appears to improve function (de Cupis et al., 2008).

In the quality trials that included a minority of patients with massive tears, there are no stratified analyses presented to identify outcomes for this specific population of patients. It has been suggested that the outcomes for patients with larger tears are inferior to smaller tears (Bengtsson et al., 2006, Bhattacharyya et al., 2014, Biberthaler et al., 2013). Patients who are candidates for surgery should have pain and reduced function and understand the risks and benefits of these procedures. Infections are generally rare and are most commonly associated with mini-open repair (Herrera, 2002). The decision as to which type of rotator cuff repair procedure to perform for massive tears must be left to the surgeon and patient until quality evidence becomes available to provide evidence-based guidance. Surgical repair of massive rotator cuff tears is invasive, has adverse effects, and is costly. Rehabilitation is often considerably longer and more complicated than for smaller rotator cuff tears. However, particularly in younger patients with massive rotator cuff tears, benefits appear to outweigh risks for most patients and surgery is generally recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Rotator Cuff Repair; arthroscopy, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 980 articles in PubMed, 5738 in Scopus, 29247 in CINAHL, 34 in Cochrane Library, 2550 in Google Scholar, and 40 from other sources†. We considered for inclusion 10 from PubMed, 0 from Scopus, 4 from CINAHL, 3 from Cochrane Library, 0 from Google Scholar, and 40 from other sources. Of the 57 articles considered for inclusion, 49 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.10.6. SUBACROMIAL DECOMPRESSION SURGERY

Surgery for impingement syndrome has been developed over many decades (1024) (1563) (1564) (1565) (1566) (540) (1567) (1568) (1569) (1570) (1571). It was originally described by Neer in 1972 as part of a continuum including surgery for rotator cuff tears, and subsequently modified to less invasive techniques. Arthroscopic approaches were then developed to attempt to further minimize surgical morbidity from large incisions and, by avoiding direct trauma to the deltoid, promote earlier active exercises and recovery and utilize lasers (1572). (1564) (1573) (1574) (1575) (1576) (1577) (1578). Arthroscopy also enhances ability to identify relevant associated pathology – partial articular side cuff tears, biceps tears, labral pathology. Impingement syndrome and rotator cuff tendinoses without tears are sometimes treated surgically, particularly after failure of non-operative treatments (1579) (1580) (1581) (1582) (298) (1583) (1584) (1585) (1570) (1571) (1586) (1587) (1080) (1588) with some arguing for aggressive treatment. (1586) As the prevalence of these conditions is exceedingly high and many individuals with tendinoses are apparently asymptomatic (see above), careful incorporation of

accurate diagnosis, the patient's condition, functional status and response to prior treatments appears particularly important. Risk factors for adverse outcomes are believed to be mostly similar to those for full-thickness rotator cuff tears and may be particularly important in the setting of workers' compensation (see above). Education regarding post-operative rehabilitation is thought to be important for these patients, as it is for those with rotator cuff tears. Claviculectomy or subacromial decompression in rotator cuff repair has been used for the treatment of rotator cuff tendinopathies (1589) (1590) (1591) (1592) (1593) (1594) (1595) (1596) (857) (1597) (1598) (1599) (1600) (1601) (1602) (1603) (1604) (1605).

SUBACROMIAL DECOMPRESSION SURGERY FOR IMPINGEMENT SYNDROME/ROTATOR CUFF TENDINOSES

Recommended

Subacromial decompression surgery is recommended for treatment of select patients with impingement syndrome/rotator cuff tendinoses.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

All of the following:
1) shoulder joint pain (e.g., symptomatic with positive supraspinatus test, impingement signs);
2) reduced active shoulder ROM or impaired function
3) imaging findings by MRI or ultrasound of rotator cuff tendinopathy consistent with symptoms; and
4) temporary resolution or marked reduction in pain immediately after injection of a local anesthetic into the subacromial space. Generally should not have scapular dyskinesia, which should be treated with exercises and is believed to be a relative contraindication to surgery (Panagiotopoulos AC, 2019, Kibler, 2006)

Patients should also have failed one or more glucocorticosteroid injections (see above) and at least one trial of a quality rehabilitation program that follows evidence-based guidelines (see above).

Benefits

Improved or resolved pain

Harms

Adhesive capsulitis, failure to improve, surgical complications

Rationale

There are no sham-surgery controlled trials of surgical interventions for impingement syndrome. However, there are several moderate-quality RCTs with many reports that compared subacromial decompression plus physical therapy versus physical therapy exercises for treatment of impingement syndrome (Paavola, 2018, Ketola, 2013, Ketola, 2015, Ketola et al., 2017, Ketola et al., 2016, Beard, 2018, Cuff et al., 2012, Rahme et al., 1998, Haahr et al., 2005, Brox et al., 1999, Ketola, 2009, Haahr et al., 2006). Importantly, one of these trials included a comparison with both exercise as well as sham-laser treatment (Svendsen et al., 2013, Brox et al., 1999). That trial found surgery and rehabilitation superior to placebo laser and provides the primary basis for an evidence-based selective

recommendation in favor of surgery, but only after other treatments have failed. All of these trials comparing physical therapy/exercise with surgery appear to have considerable biases in favor of surgery over physiotherapy/exercise for at least two major reasons: 1) patients invariably appear to have been required to fail prior non-operative treatment that when described included considerable exercise components (thus a "more of the same" bias against physical therapy/ exercise); and 2) likely greater treatment contact time in the surgical groups which were combined with physical therapy/exercise. Except for (Rahme et al., 1998), these studies reported mostly failed prior rehabilitation and found surgery superior to physical therapy exercise (Svendsen et al., 2013, Zakaria, 2004, Haahr et al., 2006). However, it also has been noted that there is a high rate of crossover to surgery over time (Brox et al., 1999).

There is moderate-quality evidence that there are no long-term differences associated with arthroscopic compared to open decompression to treat impingement syndrome/rotator cuff tendinoses (Lindh et al., 1993, Husby et al., 2003, Sachs et al., 1994), although there is some evidence of a modest short-term advantage of arthroscopy over open decompression for faster recovery (Sachs et al., 1994). (A low-quality trial also reported similar evidence (T'Jonck et al., 1997).) Open acromioplasty in patients with impingement syndrome appears not to prevent progression to rotator cuff tear in a nine-year follow-up study. (Hyvonen et al., 1998). A case-control study found no evidence that calcium deposits in the rotator cuff seen on x-ray affected outcomes at 2 years after arthroscopic subacromial decompression (Tillander et al., 1998). Experience of the surgeon and patient factors require judgment in selecting operative approaches. Long-term outcomes of up to 25 years have also reported excellent or good results in 77% of patients with various arthroscopic decompression techniques (Budoff et al., 2005, Ellman et al., 1991, Odenbring et al., 2008, Chin et al., 2007).

Limited motion may indicate adhesive capsulitis or capsular stiffness that would be a relative contraindication to surgery. Patients with rotator cuff syndromes or impingement typically do not have significant limitations of passive motion and if they do, then the diagnosis may be in doubt. Surgery is invasive, has adverse effects, and is costly. However, in carefully select patients with impingement syndrome/rotator cuff tendinoses who have failed quality non-operative treatments, benefits appear to outweigh risks and surgery is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Claviculectomy or Subacromial Decompression Or Mumford procedure or acromioplasty; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 103 articles in PubMed, 1815 in Scopus, 96 in CINAHL, 76 in Cochrane Library, 704 in Google Scholar, and 30 from other sources†. We considered for inclusion 5 from PubMed, 1 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 1 from Google Scholar, and 30 from other sources. Of the 39 articles considered for inclusion, 36 randomized trials and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If

relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ADDITION OF CLAVICULECTOMY OR SUBACROMIAL DECOMPRESSION TO A ROTATOR CUFF REPAIR FOR ISOLATED SUPRASPINATUS TEARS

Not Recommended

Adding claviculectomy or subacromial decompression to a rotator cuff repair is moderately not recommended for treatment of isolated supraspinatus tears.
Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Rationale

There is moderate-quality evidence suggesting there is no demonstrable benefit in adding subacromial decompression to a rotator cuff repair for treatment of isolated supraspinatus tears with a Type II acromion in quality studies with up to 2 years follow-up data (Rubenthaler et al., 2003, Kukkonen et al., 2015, Milano et al., 2007, Gartsman et al., 2004, Chahal et al., 2012, Oh et al., 2014)(Abrams et al., 2014) or a repair using transosseous equivalent suture-bridge technique along with subacromial decompression (Cuff et al., 2012). One trial found no statistical benefit for subacromial decompression for subacromial shoulder pain (Greenall, 2018) and another found no benefit compared with physiotherapy at 2-3 years (Farfaras et al., 2016). Yet, a trial with 10-year follow-up found better results in the subacromial decompression group than therapy (Farfaras et al., 2018). A post-hoc analysis of a different trial at 12 years found minimal, non-statistically significant improvement in the acromioplasty group (Kolk et al., 2017). There are two moderate quality studies comparing arthroscopic debridement and subacromial decompression in treatment of full-thickness tears of the rotator cuff (Melillo, 1997, Montgomery et al., 1994). Another trial found comparability between subacromial decompression and exercise at 2 years (Paavola, 2018). There is one moderate-quality trial suggesting SLAP lesions found at the same time as rotator cuff tears in those over 50 years old do not require repair, rather biceps tenotomy outperforms the SLAP repair (Franceschi et al., 2008). Thus, the quality evidence does not support the addition of clavulectomy or subacromial decompression to an isolated RC tear.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Claviculectomy or Subacromial Decompression Or Mumford procedure or acromioplasty; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 103 articles in PubMed, 1815 in Scopus, 96 in CINAHL, 76 in Cochrane Library, 704 in Google Scholar, and 0 from other sources†. We considered for inclusion 5 from PubMed, 1 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 9 articles considered for inclusion, 5 randomized trials and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search,

and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.10.7. SCAFFOLDING

Biological and synthetic scaffolding has been used to treat rotator cuff tendinopathies (516) (517)(518) (519) (494) (520) (521) (522) (519) (494) (523) (524) (525) (526) (527) (528) (529) (530).

SCAFFOLDING FOR ROTATOR CUFF TENDINOPATHY

No Recommendation

There is no recommendation for or against scaffolding for rotator cuff tendinopathy.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are few studies on scaffolding. Although one study has suggested short-term efficacy, the differences were gone by 2 years. Thus, additional research is needed before an evidence-based recommendation is possible.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Scaffolding, Biological Scaffold, Synthetic Scaffold; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 36 articles in PubMed, 214 in Scopus, 2 in CINAHL, 4 in Cochrane Library, 28 in Google Scholar, and 1 from other sources†. We considered for inclusion 11 from PubMed, 4 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 16 articles considered for inclusion, 2 randomized trials and 7 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.10.8. TENODESIS AND TENOTOMY

Tenodesis and tenotomy have been used for the treatment of bicipital tendinopathy with or without rotator cuff tendinopathies (1606) (1607) (1608) (1609) (1610) (1611) (1612) (1613) (1614) (1615) (1616) (1617) (1618) (1619) (1620) (1621) (1622) (1623) (1624) (1625) (1626) (1627) (1628) (1629)

(1630) (1631) (1632) (1633) (1634) (1635) (1636) (1637) (1029) (1638) (1639) (1640) (1641) (995) (1642) (1643) (1644) (1645) (1646) (1647) (1648) (1649) (1650) (1651) (1652) (1653) (1654) (1655) (1656) (1657) (1658) (1657) (1659) (1660) (1661) (1662) (1663).

4.6.10.9. ACELLULAR HUMAN DERMAL MATRIX

Acellular human dermal matrices can be used to treat rotator cuff tendinopathies (526) (531) (532) (533) (534) (535) (536) (537) (538) (539).

ACELLULAR HUMAN DERMAL MATRIX FOR ROTATOR CUFF TENDINOPATHY

Sometimes Recommended

Acellular human dermal matrix is selectively recommended for treatment of large rotator cuff tears.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Repair of large cuff tears

Benefits

Improved function and improved tendon healing at 2 years

Harms

Increased post-operative complication rate

Rationale

One RCT suggests considerable efficacy for the treatment of large cuff tears (Barber et al., 2012). Thus, acellular human dermal matrix augmentation is selectively recommended for large cuff tears.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Acellular Human Dermal Matrix; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 8 articles in PubMed, 96 in Scopus, 3 in CINAHL, 1 in Cochrane Library, 33 in Google Scholar, and 0 from other sources†. We considered for inclusion 3 from PubMed, 5 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 8 articles considered for inclusion, 1 randomized trial and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If

relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.10.10. RECOMBINANT HUMAN BONE MORPHOGENETIC PROTEIN-12 (RHBMP-12)

Recombinant Human Bone Morphogenetic Protein-12 (rhBMP-12) has been used to treat tendon injuries, including rotator cuff tendinopathies (248) (249).

RECOMBINANT HUMAN BONE MORPHOGENETIC PROTEIN-12 (RHBMP-12) FOR ROTATOR CUFF TENDINOPATHY

No Recommendation

There is no recommendation for or against recombinant human bone morphogenetic protein-12.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are small studies, but no moderate- or large-scale studies with clinical outcome measures suggesting efficacy. Thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Recombinant Human Bone Morphogenetic Protein-12 (rhBMP-12); rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 1 article in PubMed, 127 in Scopus, 1 in CINAHL, 1 in Cochrane Library, 0 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.10.11. SUPERIOR CAPSULE RECONSTRUCTION

SUPERIOR CAPSULE RECONSTRUCTION

No Recommendation

There is no recommendation for or against superior capsule reconstruction (SCR).

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality literature addressing superior capsule reconstruction and thus there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Superior capsule reconstruction; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 17 articles in PubMed, 92 in Scopus, 11 in CINAHL, 2 in Cochrane Library, 445 in Google Scholar, and 0 from other sources†. We considered for inclusion 11 from PubMed, 0 from Scopus, 4 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 15 articles considered for inclusion, 0 randomized trials and 6 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

4.6.10.12. RADIOFREQUENCY MICROTENOTOMY

Radiofrequency microtenotomy has been used to treat rotator cuff tendinopathies (540) (541) (542) (543) (544).

RADIOFREQUENCY MICROTENOTOMY FOR ROTATOR CUFF TENDINOPATHIES

Not Recommended

Radiofrequency microtenotomy is not recommended for adjunctive treatment with subacromial decompression or bursectomy.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Low

Rationale

Two RCTs have assessed radiofrequency microtenotomy, both suggesting a lack of additive benefit to subacromial decompression (Lu et al., 2013) or bursectomy (Al-Ani et al., 2019); thus, it is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Radiofrequency Microtenotomy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 4 articles in PubMed, 127 in Scopus, 2 in CINAHL, 7 in Cochrane Library, 27 in Google Scholar, and 3 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 3 from other sources. Of the 7 articles considered for inclusion, 2 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

5. BICIPITAL TENDINOPATHY AND RUPTURED BICIPITAL TENDON

5.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing Bicipital Tendinopathy and Ruptured Bicipital Tendon from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

Category	Recommendation	Evidence
Diagnostic Tests	Magnetic Resonance Imaging for Bicipital Tendinopathy	No Recommendation, Insufficient Evidence (I)
Nonoperative	Non-Invasive Treatments for Bicipital Tendinopathy	See text
Injections	Glucocorticosteroid Injections for Acute, Subacute, or Chronic Bicipital Tendinopathy	Recommended, Insufficient Evidence (I)
	Platelet-rich Plasma Injections for Bicipital Tendinopathy	No Recommendation, Insufficient Evidence (I)
	Stem Cell Injections for Bicipital Tendinopathy	No Recommendation, Insufficient Evidence (I)
Surgery	Surgery for Select Patients with Bicipital Tendon Tears	Recommended, Insufficient Evidence (I)
	Biceps Tenotomy and Tenodesis for Bicipital Tendinopathies	No Recommendation, Insufficient Evidence (I)

5.2. OVERVIEW

Bicipital tendinopathy involving the proximal long head of the biceps tendon (bicipital tendon) is usually due to degenerative changes in the tendon or wear in the bicipital groove. The bicipital tendon sheath may also be involved in inflammatory arthropathies. (Note that the distal end of the biceps is involved in biceps strains and ruptures at the elbow, which typically have significantly different prognoses; see Elbow Disorders Guideline.) Bicipital tendinopathy is believed to be analogous and parallel to and have the same pathophysiological basis as the rotator cuff, including having tenuous vascular supply to the affected areas. It is recommended that symptomatic bicipital tendinopathy be managed as noted in the Rotator Cuff Tendinopathies section, including the selective use of low-dose glucocorticosteroid injection. Bicipital tendon rupture may be managed non-operatively for the vast majority of patients as there is no accompanying functional disability. Surgery, typically tenodesis, may be desired for cosmetic reasons, especially in select athletes and bodybuilders or others concerned with cosmesis, but it is not necessary for restoration of function in the general population (545).

5.3. DIAGNOSTIC RECOMMENDATIONS

Magnetic resonance imaging (MRI) has been used to diagnose bicipital tendinopathy (546) (547) (548) (549) (550) (551) (552) (553) (554).

MAGNETIC RESONANCE IMAGING FOR BICIPITAL TENDINOPATHY

No Recommendation

There is no recommendation for or against MRI to diagnose bicipital tendinopathy.
Strength of evidence No Recommendation, Insufficient Evidence (I)

Level of confidence Low

Rationale

There are no quality studies on the use of MRI for the diagnosis of bicipital tendinopathy. The bicipital tendon is relatively superficial and is accessible with physical examination, which helps obviate the need for MRI, especially as the tendon is prone to degeneration. Thus, abnormal MRIs in the absence of disease are predictable. Therefore, there is no recommendation for MRI. However, MRI may be indicated for patients with rotator cuff-related problems.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: magnetic resonance imaging (MRI); bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 2,530 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 2,530 articles, 19,545 in Scopus, 226 in CINAHL, 1,973 in Cochrane Library, 2,650 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

5.4. TREATMENT RECOMMENDATIONS

5.4.1. INITIAL CARE

Initial care of bicipital tendinopathies nearly always involves non-operative treatment, including among those with a complete tear. Educating the patient regarding the generally good long-term prognosis regardless of the presence or absence of a tear and need to continue use and ROM exercises is recommended. For patients with significant pain, over-the-counter (OTC) analgesics (NSAIDs, acetaminophen) and self-applications of heat and ice are recommended. Slings and immobilizers are not recommended.

Bicipital tendinopathy treatment recommendations largely require inference from RCTs (other than for injections and surgery, see below), as quality studies are not currently available. Thus, all of these inferential recommendations are listed as “Insufficient Evidence (I)” with low levels of confidence. See also the Indications, Harms, Benefits, Frequency/Dose/Duration, Indications for Discontinuation, and Rationale in the Rotator Cuff Tendinopathies recommendations.

5.4.2. ACTIVITY MODIFICATION AND EXERCISE

Bicipital tendinopathy treatment recommendations largely require inference from RCTs (other than for injections and surgery, see below), as quality studies are not currently available. Thus, all of these inferential recommendations are listed as "Insufficient Evidence (I)" with low levels of confidence. See also the Indications, Harms, Benefits, Frequency/Dose/Duration, Indications for Discontinuation, and Rationale in the Rotator Cuff Tendinopathies recommendations.

EXERCISE PRESCRIPTIONS FOR BICIPITAL TENDINOPATHIES

Recommended

Exercise prescriptions are recommended for the treatment of bicipital tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Exercise, Exercise Therapy; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 988 articles in PubMed, 38641 in Scopus, 481 in CINAHL, 495 in Cochrane Library, 553 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Zero articles met the inclusion criteria.

RANGE-OF-MOTION EXERCISE FOR BICIPITAL TENDINOPATHIES

Recommended

Range-of-motion exercise is recommended for the treatment of bicipital tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Exercise, Exercise Therapy; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 988 articles in PubMed, 38641 in Scopus, 481 in CINAHL, 495 in Cochrane Library, 553 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

STRENGTHENING EXERCISE FOR BICIPITAL TENDINOPATHIES

Recommended

Strengthening exercise is recommended for the treatment of bicipital tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Exercise, Exercise Therapy; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 988 articles in PubMed, 38641 in Scopus, 481 in CINAHL, 495 in Cochrane Library, 553 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

AEROBIC EXERCISE FOR BICIPITAL TENDINOPATHIES

Recommended

Aerobic exercise is recommended for the treatment of bicipital tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Exercise, Exercise Therapy; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 988 articles in PubMed, 38641 in Scopus, 481 in CINAHL, 495 in Cochrane Library, 553 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

5.4.3. MEDICATIONS

Bicipital tendinopathy treatment recommendations largely require inference from RCTs (other than for injections and surgery, see below), as quality studies are not currently available. Thus, all of these inferential recommendations are listed as "Insufficient Evidence (I)" with low levels of confidence. See also the Indications, Harms, Benefits, Frequency/Dose/Duration, Indications for Discontinuation, and Rationale in the Rotator Cuff Tendinopathies recommendations.

NSAIDS FOR BICIPITAL TENDINOPATHIES

Recommended

NSAIDs are recommended for the treatment of bicipital tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Nonsteroidal anti-inflammatory drugs (NSAID); COX-2 inhibitors, ketorolac, ibuprofen, dexketoprofen, celecoxib, parecoxib, rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis, bicipital tendinosis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 185 articles in PubMed, 599 in Scopus, 31 in CINAHL, 42 in Cochrane Library, 46 in Google Scholar, and 2 from other sources†. We considered for inclusion 8 from PubMed, 7 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 18 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ACETAMINOPHEN FOR BICIPITAL TENDINOPATHIES

Recommended

Acetaminophen is recommended for the treatment of bicipital tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Acetaminophen, paracetamol; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis, bicipital tendinosis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 38 articles in PubMed, 1810 in Scopus, 20 in CINAHL, 20 in Cochrane Library, 148 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 4 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

CAPSICUM FOR BICIPITAL TENDINOPATHIES

Not Recommended

Capsicum is recommended for the treatment of bicipital tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Topical Creams; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 1 article in PubMed, 552 in Scopus, 0 in CINAHL, 2 in Cochrane Library, 23 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

GABAPENTIN FOR BICIPITAL TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of gabapentin for the treatment of bicipital tendinopathies.

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

TOPICAL NSAIDS FOR BICIPITAL TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of topical NSAIDs for the treatment of bicipital tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Topical NSAIDS; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 187 articles in PubMed, 931 in Scopus, 14 in CINAHL, 6 in Cochrane Library, 62 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

LIDOCAINE PATCHES FOR BICIPITAL TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of lidocaine patches for the treatment of bicipital tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Lidocaine Patches; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 2 articles in PubMed, 684 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 35 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SYSTEMIC ORAL STEROIDS FOR BICIPITAL TENDINOPATHIES

Not Recommended

Systemic oral steroids are not recommended for the treatment of bicipital tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

5.4.4. ELECTRICAL THERAPIES

Bicipital tendinopathy treatment recommendations largely require inference from RCTs (other than for injections and surgery, see below), as quality studies are not currently available. Thus, all of these inferential recommendations are listed as "Insufficient Evidence (I)" with low levels of confidence. See also the Indications, Harms, Benefits, Frequency/Dose/Duration, Indications for Discontinuation, and Rationale in the Rotator Cuff Tendinopathies recommendations.

TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION FOR BICIPITAL TENDINOPATHIES

Recommended

Transcutaneous electrical nerve stimulation is recommended for the treatment of bicipital tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

ELECTRICAL MUSCLE STIMULATION FOR BICIPITAL TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of electrical muscle stimulation for the treatment of bicipital tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

EXTRACORPOREAL SHOCKWAVE THERAPY FOR BICIPITAL TENDINOPATHIES

Not Recommended

Extracorporeal shockwave therapy is not recommended for the treatment of bicipital tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

5.4.5. HOT AND COLD THERAPIES

Bicipital tendinopathy treatment recommendations largely require inference from RCTs (other than for injections and surgery, see below), as quality studies are not currently available. Thus, all of these

inferential recommendations are listed as “Insufficient Evidence (I)” with low levels of confidence. See also the Indications, Harms, Benefits, Frequency/Dose/Duration, Indications for Discontinuation, and Rationale in the Rotator Cuff Tendinopathies recommendations.

HEAT THERAPIES FOR BICIPITAL TENDINOPATHIES

Recommended

Heat therapies are recommended for the treatment of bicipital tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

COLD THERAPIES FOR BICIPITAL TENDINOPATHIES

Recommended

Cold therapies are recommended for the treatment of bicipital tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

DIATHERMY FOR BICIPITAL TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of diathermy for the treatment of bicipital tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

INFRARED THERAPY FOR BICIPITAL TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of infrared therapy for the treatment of bicipital tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

5.4.6. ALLIED HEALTH INTERVENTIONS

Bicipital tendinopathy treatment recommendations largely require inference from RCTs (other than for injections and surgery, see below), as quality studies are not currently available. Thus, all of these inferential recommendations are listed as “Insufficient Evidence (I)” with low levels of confidence. See also the Indications, Harms, Benefits, Frequency/Dose/Duration, Indications for Discontinuation, and Rationale in the Rotator Cuff Tendinopathies recommendations.

ACUPUNCTURE FOR BICIPITAL TENDINOPATHIES

Recommended

Acupuncture is recommended for the treatment of bicipital tendinopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Acupuncture; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis, bicipital tendinosis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 1 articles in PubMed, 1678 in Scopus, 127 in CINAHL, 1 in Cochrane Library, 275 in Google Scholar, and 11 from other sources†. We considered for inclusion 1 from PubMed, 3 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 11 from other sources. Of the 17 articles considered for inclusion, 1 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANUAL THERAPY FOR BICIPITAL TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of manual therapy for the treatment of bicipital tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

MOBILIZATION FOR BICIPITAL TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of mobilization for the treatment of bicipital tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

MANIPULATION (SHOULDER) FOR BICIPITAL TENDINOPATHIES

No Recommendation

There is no recommendation for or against the use of shoulder manipulation for the treatment of bicipital tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

BALNEOTHERAPY FOR BICIPITAL TENDINOPATHIES

Not Recommended

Balneotherapy is not recommended for the treatment of bicipital tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

LOW-LEVEL LASER THERAPY FOR BICIPITAL TENDINOPATHIES

Not Recommended

Low-level laser therapy is not recommended for the treatment of bicipital tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

INTERFERENTIAL THERAPY FOR BICIPITAL TENDINOPATHIES

Not Recommended

Interferential therapy is not recommended for the treatment of bicipital tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

ULTRASOUND FOR BICIPITAL TENDINOPATHIES

Not Recommended

Ultrasound is not recommended for the treatment of bicipital tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

MANIPULATION (NECK OR BACK) FOR BICIPITAL TENDINOPATHIES

Not Recommended

Manipulation of the neck or back is not recommended for the treatment of bicipital tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

5.4.7. DEVICES

Bicipital tendinopathy treatment recommendations largely require inference from RCTs (other than for injections and surgery, see below), as quality studies are not currently available. Thus, all of these inferential recommendations are listed as “Insufficient Evidence (I)” with low levels of confidence. See also the Indications, Harms, Benefits, Frequency/Dose/Duration, Indications for Discontinuation, and Rationale in the Rotator Cuff Tendinopathies recommendations.

SLINGS AND SUPPORTS FOR BICIPITAL TENDINOPATHIES

Not Recommended

Slings and supports are not recommended for the treatment of bicipital tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

TAPING AND KINESIOTAPING FOR BICIPITAL TENDINOPATHIES

Not Recommended

Taping and kinesiotaping are not recommended for the treatment of bicipital tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

MAGNETS FOR BICIPITAL TENDINOPATHIES

Not Recommended

Magnets are not recommended for the treatment of bicipital tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

MAGNETIC STIMULATION FOR BICIPITAL TENDINOPATHIES

Not Recommended

Magnetic stimulation is not recommended for the treatment of bicipital tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

5.4.8. INJECTION THERAPIES

Glucocorticosteroid injections have been used for treatment of bicipital tendinopathy (555) (442) (556) (557) (558).

GLUCOCORTICOSTEROID INJECTIONS FOR ACUTE, SUBACUTE, OR CHRONIC BICIPITAL TENDINOPATHY

Recommended

Glucocorticosteroid injections are recommended for treatment of acute, subacute, and chronic bicipital tendinopathy.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Moderate to severe pain from bicipital tendinopathy that is not satisfactorily controlled with NSAID(s) or acetaminophen.

Benefits

Improved or resolved pain.

Harms

Steroid flare after an injection; rare infection, potential for tendon rupture, especially with accidental intra-tendon injection, although the condition is associated with a baseline degenerative tendon.

Frequency/Dose/Duration

Single injection should be scheduled and results evaluated, rather than scheduling a series of injections. If there are concerns about concomitant symptomatic rotator cuff tendinopathy, then simultaneous double injections of the subacromial space and long head of the biceps may be attempted (Wang, 2019). A second injection after waiting at least 2 weeks may be reasonable if the response is suboptimal or the tendon sheath region was felt to have not been adequately addressed, though it would be appropriate to consider a different technique or imaging. RCTs have utilized triamcinolone acetonide 40mg (Wang, 2019), triamcinolone acetate 40 mg (Yiannakopoulos et al., 2020), However, as the target tissue space is relatively small in comparison with the subacromial space and there is propensity for rupture, a low dose (e.g., methylprednisolone 10-20mg) is advised for an initial injection. A higher dose may be advised if the results from the first injection are inadequate.

Indications for Discontinuation

A second glucocorticosteroid injection is not recommended if the first injection has resulted in significant reduction or resolution of symptoms. If there are concerns about concomitant symptomatic rotator cuff tendinopathy, then simultaneous double injections of the subacromial space and long head of the biceps may be attempted (Wang, 2019). If there has not been a response to a first injection, there is generally less indication for a second. If there is reason to believe the medication was not well placed (e.g., no post-injection anesthesia from the anesthetic) and/or if the underlying condition is so severe that one steroid bolus could not be expected to adequately treat the condition, a second injection may be indicated. There is evidence from two small randomized studies that ultrasound guidance improves results (Yiannakopoulos et al., 2020) and accuracy (Hashiuchi et al., 2011). Thus, the use of US guidance is both acceptable/recommended for coverage, but it is also not essential.

Rationale

There are no placebo-controlled trials. There is one small-sized, moderate quality study suggesting ultrasound guidance is helpful, but the evidence also suggests use of US-guidance is not essential (Yiannakopoulos et al., 2020). Another RCT found greater accuracy with US guidance, but included no medication (Hashiuchi et al., 2011); thus, whether the results would be meaningfully different clinically was not determined. Injections are invasive, have a low risk of adverse effects and are moderately costly. They are thought to be effective for bicipital tendinopathy and thus are recommended. Due to risk of bicipital rupture, which is common with this degenerative tendon problem, a low dose of steroid is advised for an initial injection.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Glucocorticosteroid Injections; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 7 articles in PubMed, 256 in Scopus, 0 in CINAHL, 5 in Cochrane Library, 81 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 3 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PLATELET-RICH PLASMA INJECTIONS FOR BICIPITAL TENDINOPATHY

No Recommendation

There is no recommendation for or against the use of subacromial platelet-rich plasma (PRP) injections for the treatment of bicipital tendinopathy.

[58.33% panel agreement on No Recommendation. 8.33% agreed with Recommended and 33.33% agreed with Not Recommended.]

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials of PRP injections. By analogy for the similar pathophysiological condition of rotator cuff tendinopathy, the literature conflicts. Thus, there is no recommendation for or against PRP injections for bicipital tendinopathy. The panel vote as split as noted above.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Platelet-rich Plasma Injections; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 178 articles in PubMed, 5760 in Scopus, 41 in CINAHL, 57 in Cochrane Library, 98 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

STEM CELL INJECTIONS FOR BICIPITAL TENDINOPATHY

No Recommendation

There is no recommendation for stem cell therapy for bicipital tendinopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies, and thus there is no recommendation regarding stem cell therapy for bicipital tendinopathies.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Stem cell injections, stem cell

therapy, stem cell, hematopoietic stem cells, hematopoietic stem cell transplantation; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 34 articles in PubMed, 70 in Scopus, 13 in CINAHL, 1 in Cochrane Library, 91 in Google Scholar, and 0 from other sources†. We considered for inclusion 4 from PubMed, 2 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

5.4.9. SURGICAL CONSIDERATIONS

Surgery for select patients with bicipital tendon tears has been used to treat bicipital tendinopathy (1612) (1636) (1664) (1665) (1634) (1666) (1644) (1667) (1668).

Rotator cuff repair surgery has been performed at the same time as treatment for bicipital tendinopathy (see Rotator Cuff Tendinopathy).

Tenodesis and tenotomy have been used for the treatment of bicipital tendinopathy with or without rotator cuff tendinopathies (1606) (1607) (1608) (1609) (1610) (1611) (1612) (1613) (1614) (1615) (1616) (1617) (1618) (1619) (1620) (1621) (1622) (1623) (1624) (1625) (1626) (1627) (1628) (1629) (1630) (1631) (1632) (1633) (1634) (1635) (1636) (1637) (1029) (1638) (1639) (1640) (1641) (995) (1642) (1643) (1644) (1645) (1646) (1647) (1648) (1649) (1650) (1651) (1652) (1653) (1654) (1655) (1656) (1658) (1657) (1659) (1660) (1661) (1662) (1663) (1669) (1670) (1671) (1672) (1673) (1674) (1675) (1676) (1677).

SURGERY FOR SELECT PATIENTS WITH COMPLETE BICIPITAL TENDON TEARS

Sometimes Recommended

Surgery is recommended for select patients with complete bicipital tendon tears.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Rare patients with significant incapacity due to the tear, generally having very high physically-demanding jobs, as the long head and bicipital tendon play a negligible role in the dynamic stability and/or strength of the shoulder. Surgical procedure is usually tenodesis and not repair.

Benefits

Primarily cosmetic. Less risk of popeye deformity after tenodesis than tenotomy (Castricini, 2018, MacDonald et al., 2020, De Carli et al., 2012, Cai et al., 2019, Woodmass et al., 2021), including if combined with rotator cuff repair (Lee et al., 2016); however, earlier pain relief has been reported from tenotomy (Belay et al., 2019, Zhang et al., 2015).

Harms

Risk of infection, pain associated with surgery, surgical complications. Increased risk of humeral fracture.

Frequency/Dose/Duration

The most common reasons for revision surgery are reportedly pain, cramping and re-rupture.

Indications for Discontinuation

Not applicable.

Rationale

There are no RCTs comparing surgical with non-operative management. There are many moderate quality trials comparing types of surgeries, especially comparing tenotomy and tenodesis. There is no quality evidence that tenodesis is clearly superior to tenotomy, although there is less risk of popeye deformity after tenodesis than tenotomy (Castricini, 2018, MacDonald et al., 2020, De Carli et al., 2012, Cai et al., 2019)(Woodmass et al., 2021), including if combined with rotator cuff repair (Lee et al., 2016); however, earlier pain relief has been reported from tenotomy (Belay et al., 2019, Zhang et al., 2015). Thus, there is no recommendation of tenodesis compared with tenotomy.

The bicipital tendon is not required for function of the shoulder or arm and thus it generally does not require surgical repair. The primary indications for surgical repair are related to cosmesis, and potentially intolerable pain thought to be emanating from the bicipital tendinopathy. Thus, surgical repair is not indicated for the vast majority of patients with these ruptures and is selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Surgery, tenodesis, tenotomy; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 2818 articles in PubMed, 73581 in Scopus, 580 in CINAHL, 430 in Cochrane Library, 97 in Google Scholar, and 12 from other sources†. We considered for inclusion 6 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 12 from other sources. Of the 18 articles considered for inclusion, 11 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ROTATOR CUFF REPAIR WITH BICIPITAL TENDINOPATHY

No Recommendation

Rotator cuff repair surgery has been performed at the same time as treatment for bicipital tendinopathy. (See Rotator Cuff Tendinopathy.)
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Rotator Cuff Repair; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 275 articles in PubMed, 12850 in Scopus, 61 in CINAHL, 65 in Cochrane Library, 559 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trial and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TENODESIS OR TENOTOMY FOR BICIPITAL TENDINOPATHY WITH ROTATOR CUFF TEARS

No Recommendation

There is no recommendation for tenodesis or tenotomy for treatment of long head of the biceps tendinopathy in combination with rotator cuff tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are multiple trials comparing tenodesis with tenotomy for treatment of biceps tendinopathies with or without cuff tears. The literature shows no significant differences between the two approaches (Belay et al., 2019, Castricini, 2018, Hufeland, 2019, Lee et al., 2016, Zhang et al., 2015, Mardani-Kivi et al., 2019, De Carli et al., 2012) and between high vs. subpectoral tenodesis (Franceschetti, 2020) and suprapectoral vs. open subpectoral tenodesis (Forsythe, 2020). There also is no difference at 4-years between detaching or not detaching the bicipital tendon (Franceschi, 2007). Thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Tenodesis; rotator cuff

tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 113 articles in PubMed, 1391 in Scopus, 65 in CINAHL, 18 in Cochrane Library, 189 in Google Scholar, and 0 from other sources†. We considered for inclusion 50 from PubMed, 9 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 60 articles considered for inclusion, 7 randomized trials and 6 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Biceps Tenotomy; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 94 articles in PubMed, 926 in Scopus, 29 in CINAHL, 1 in Cochrane Library, 94 in Google Scholar, and 0 from other sources†. We considered for inclusion 3 from PubMed, 5 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 8 articles considered for inclusion, 1 randomized trial and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

5.4.10. REHABILITATION PROGRAMS

Bicipital tendinopathy treatment recommendations largely require inference from RCTs (other than for injections and surgery, see below), as quality studies are not currently available. Thus, all of these inferential recommendations are listed as “Insufficient Evidence (I)” with low levels of confidence. See also the Indications, Harms, Benefits, Frequency/Dose/Duration, Indications for Discontinuation, and Rationale in the Rotator Cuff Tendinopathies recommendations.

POSTOPERATIVE REHABILITATION FOR BICIPITAL TENDINOPATHIES

Recommended

Postoperative rehabilitation is recommended for the treatment of bicipital tendinopathies.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Physical Therapy; bicipital tendinosis, bicipital tendinopathy, shoulder pain, ruptured bicipital tendon, biceps tendon tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 1,527 articles in PubMed, 15,173 in Scopus, 227 in CINAHL, 509 in Cochrane Library, 519 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 1 from Scopus, 5 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

5.4.11. FOLLOW-UP VISITS

Patients with bicipital tendinopathies usually require follow-up appointments, particularly if they are undergoing active treatment(s), need assistance with advancing a course of exercises, and/or require significant work limitations that need frequent adjustments. Frequencies of appointments may also be greater when more workplace limitations are required and job demands are greater. The rare patients with bicipital tears who undergo surgical repair may require at least several weeks to a couple months of post-operative rehabilitation. Patients with bicipital tears managed non-operatively may require longer duration limitations and slower recovery may occur, particularly if there is concomitant rotator cuff tendinopathy. In those cases, the patient may require therapy on a prolonged basis in order to recover as much function as possible.

6. SHOULDER OSTEOARTHROSIS (GLENOHUMERAL AND ACROMIOCLAVICULAR JOINT)

6.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing Shoulder Osteoarthrosis from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level

- Recommended, “C” Level
- Insufficient – Recommended (Consensus-based), “I” Level
- Insufficient – No Recommendation (Consensus-based), “I” Level
- Insufficient – Not Recommended (Consensus-based), “I” Level
- Not Recommended, “C” Level
- Moderately Not Recommended, “B” Level
- Strongly Not Recommended, “A” Level

6.2. OVERVIEW

The shoulder joints are substantially less likely to be affected by osteoarthrosis (one type of degenerative joint disease) than other joints such as the knees, hips, spine, or fingers. As with other joints, there may be multiple diagnostic causes of the degenerative findings on x-ray, only one of which is osteoarthrosis. Careful evaluation is required to identify the correct diagnosis. While most osteoarthrosis cases are not work related, some cases, especially unilateral, ipsilateral post-occupational fracture-related arthroses, are thought to be occupationally related.

6.3. WORK LIMITATIONS

Glenohumeral and AC joint osteoarthroses generally do not require work limitations. Occasionally limitations are required in severe cases to preclude significant symptomatic aggravation especially for more physically demanding work such as preventing overhead use, lifting of more than 15 pounds, repeated forceful use, and/or avoidance of other activities that significantly increase symptoms. Shoulder arthroplasty generally precludes return to physically demanding work.

6.4. DIAGNOSTIC CRITERIA

A degenerative joint disease diagnosis requires non-radiating pain and degenerative findings on x-ray. Confirming a diagnosis of osteoarthrosis requires attention to the history, evaluation of other joints, and exclusion of other causes, such as inflammatory or crystal arthropathies and rotator cuff tendinopathy and labral tears.

6.5. DIAGNOSTIC RECOMMENDATIONS

6.5.1. ANTIBODIES

There are numerous antibodies that are markers for specific inflammatory arthropathies (e.g., rheumatoid factor, anti-nuclear antibodies, anti-Sm, anti-Ro, anti-La for rheumatoid arthritis, systemic lupus erythematosus, Sjogren’s, mixed connective tissue disorder, etc.) (559,560). Patients with inflammatory arthropathies are at increased risk for degenerative joint disease of the shoulder joints, as well as subacromial bursitis.

ANTIBODIES TO CONFIRM SPECIFIC DISORDERS

Sometimes Recommended

Antibody levels are selectively recommended to evaluate and diagnose patients with shoulder pain that have reasonable suspicion of rheumatological disorders including inflammatory arthropathies.

Antibody levels are strongly recommended as a screen to confirm specific rheumatological disorders when there are indications (e.g., symptoms and/or signs suggestive of rheumatoid arthritis), but are generally not indicated for most patients with other specific soft tissue musculoskeletal disorders, such as rotator cuff tendinopathies due to high false positive rates in that non-specific diagnostic setting. Consultation with a rheumatologist may be helpful when there is a known or suspected disorder.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Shoulder pain and a presumptive diagnosis of an inflammatory rheumatological disorder. May include pain that fails to respond as would be expected, with or without findings in other joints. Findings in other joints increases the probability that testing will be positive. Testing is generally not indicated for most patients with rotator cuff tendinopathies. Testing is also not generally indicated at initial symptoms presentation unless symptoms have been present for at least a few weeks and/or are severe; otherwise, e.g., negative test results are more likely as insufficient time is likely to have passed and may mislead.

Benefits

Secure an accurate diagnosis, which should then focus the treatment plan to more efficacious treatments.

Harms

Potential for false-positive tests; however that is generally minimal unless the pre-test probability is low.

Frequency/Dose/Duration

Generally only ordered one time. However, if the testing was performed early and there is further disease persistence or progression, a second test is reasonable as more time may be required for the antibody tests to become positive.

Rationale

Elevated antibody levels are highly useful for confirming clinical impressions of inflammatory rheumatological diseases. However, routine use of these tests in shoulder pain patients is not recommended, especially as wide-ranging, non-focused test batteries are likely to result in inaccurate diagnoses due to false positives and low pre-test probabilities. Providers should also be aware that false-negative results occur. Measurement of antibody levels is minimally invasive, unlikely to have substantial adverse effects, and is low to moderately costly depending on the specific test ordered. They are recommended for focused testing of a limited number of diagnostic considerations. However, ordering of a large, diverse array of antibody levels without targeting a few specific disorders diagnostically is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Antibodies; rotator cuff

tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 9 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 9 articles, 676 in Scopus, 2 in CINAHL, 1 in Cochrane Library, 119 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.2. C-REACTIVE PROTEIN

There are many markers of inflammation that may be measured serologically in patients (109,110,117,112,113,114,115). These include C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), aldolase, interleukins, ferritin, and an elevated total protein-albumin gap. These non-specific inflammatory markers may be helpful in evaluating patients with shoulder degenerative joint diseases (561,562,563,564,565,566,567,568,569,570,571,572).

NON-SPECIFIC INFLAMMATORY MARKERS FOR SCREENING FOR INFLAMMATORY DISORDERS IN SUBACUTE OR CHRONIC SHOULDER PAIN

Sometimes Recommended

Serum measures of erythrocyte sedimentation rate, C-reactive protein, creatine kinase muscle, aldolase, hyaluronic acid, and other inflammatory markers are selectively recommended for screening either inflammatory disorders with reasonable suspicion of inflammatory disorder in patients with subacute or chronic shoulder pain or osteoarthrosis. They are generally not indicated for patients with non-specific disorders, such as rotator cuff tendinopathies.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Shoulder pain and a presumption of an inflammatory process. Pain that fails to respond as would be expected, with or without findings in other joints. Findings in other joints increases the probability that testing will be positive. Testing is generally not indicated for most patients with rotator cuff tendinopathies. Testing is also not generally indicated at initial symptoms presentation unless symptoms have been present for at least a few weeks and/or are severe; otherwise, e.g., negative test results are more likely as insufficient time is likely to have passed and may mislead.

Benefits

Identify whether an inflammatory process is likely, which may help focus on the need for further testing to secure an accurate diagnosis.

Harms

Potential for false-positive tests; however, that is generally minimal unless the pre-test probability is low.

Frequency/Dose/Duration

Generally only ordered one time. However, if the testing was performed early, and there is further disease persistence or progression, a second test is reasonable as the inflammatory mediators may have needed additional time to become positive.

Rationale

Erythrocyte sedimentation rate (ESR) is the most commonly used systemic marker for non-specific inflammation. It is elevated in numerous inflammatory conditions including rheumatological disorders as well as infectious diseases. C-reactive protein (CRP) is a marker of systemic inflammation that has been associated with an increased risk of coronary artery disease. It is also a non-specific marker for other inflammation. Both ESR and CRP are also markers of infection. Numerous inflammatory markers have been found to be elevated in patients with musculoskeletal disorders but because it is not known whether these factors precede or are a consequence of the disease processes, their utility in patient management is unclear. Other non-specific markers of inflammation include elevated ferritin and an elevated protein-albumin gap, neither of which have known clinical roles. Serological studies for non-specific inflammatory markers are minimally invasive, have low risk of adverse effects, and are low cost. They are recommended as a reasonable screen for systemic inflammatory conditions especially if the patient also has other pain without clear definition of a diagnosis or those with fibromyalgia or myofascial pain syndrome, although specificity is not high. However, ordering of a large, diverse array of anti-inflammatory markers without targeting a few specific disorders diagnostically is not recommended.
A large study found elevated biomarkers (C-reactive protein, creatine kinase muscle, aldolase) are associated with osteoarthrosis compared with normal controls (Ganguly, 2019). Another study found elevated serum hyaluronic acid levels among both those with either rheumatoid arthritis or osteoarthrosis, although the HA levels were higher among those with rheumatoid arthritis (Goldberg RL, 1991) and TNF alpha, IL-1B, IL-10 and IL-17 (Hussein et al., 2008). However, clear distinctions between these measures among those with osteoarthrosis and inflammatory arthropathies is not apparent in the available literature. Thus, the utility of these tests may be as potential screening for arthropathies irrespective of inflammatory arthroses.
A high-quality, 7-year study of 880 elderly subjects evaluated impacts of IL-6 and CRP on both cross-sectional associations with morbidity and long-term mortality (Taaffe DR, 2000). CRP and IL-6 were higher among smokers at baseline and those with higher body mass indexes (BMIs). IL-6 and CRP were also higher among those with hypertension, myocardial infarction, stroke, glycosylated hemoglobin levels, HDL, and number of chronic conditions. Both IL-6 and CRP were inversely related to quartiles of moderate and strenuous physical activity. CRP and/or IL-6 were associated with incidence of hypertension, myocardial infarction, diabetes, and incident cases of chronic conditions. Physical performance measures of changes in grip strength, signature time, chair-rise and 6-m fast walk all were not significant for IL-6 or CRP.

Serological studies for non-specific inflammatory markers are minimally invasive, have low risk of adverse effects, and are low cost. They are recommended as a screen for systemic inflammatory and osteoarthrosis conditions especially if the patient also has other pain without clear definition of a diagnosis, although specificity is not high and these measures tend to be elevated in both

osteoarthrosis and inflammatory disorders, with higher levels among those with inflammatory disorders. However, ordering of a large, diverse array of anti-inflammatory markers without targeting a few specific disorders diagnostically is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: blood sedimentation, c reactive protein, procalcitonin, nonspecific inflammatory markers; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 6 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 6 articles, 756 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 11,000 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 6 from Google Scholar, and 0 from other sources. Of the 8 articles considered for inclusion, 5 diagnostic studies and 0 systematic reviews met the inclusion criteria.†

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cytokines; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 12 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 12 articles, 1030 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 12,000 in Google Scholar, and 0from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.†

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: C-Reactive Protein, Erythrocyte Sedimentation Rate, Non-Specific Inflammatory Markers; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 35 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 37 articles, 61 in Scopus, 10 in CINAHL, 3 in Cochrane Library, 171 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.3. X-RAYS

X-ray is the most basic anatomical test for arthritides and degenerative joint disease (126,127,573,574,575). Osteoarthrosis is characterized by four chief features on x-ray: joint space narrowing, subchondral bone sclerosis, marginal osteophytes, and subchondral cysts (576). The differential diagnosis for degenerative joint disease includes gout, pseudogout, hydroxyapatite deposition disease, rheumatoid arthritis, psoriasis, etc., which may or may not have differences with findings from osteoarthrosis-related degenerative joint disease. American College of Radiography guidelines have been published (577,578).

X-RAYS FOR EVALUATION OF SHOULDER OSTEOARTHROSIS

Recommended

X-rays are recommended for evaluation of acute, subacute, or chronic shoulder pain and arthritis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Most patients with shoulder pain are candidates for x-rays, especially for significant trauma, pain without trending towards improvement, impaired use, and those with red flags. Age has been found to be a potent predictor of increased degenerative changes found on x-ray in the acromioclavicular joint (Bonsell et al., 2000), and changes in the critical angle combined with age have been found to predict glenohumeral pathology. Reportedly, x-ray has been helpful for diagnosing os acromiale in shoulder pain patients who were otherwise thought to not have the condition (Burbank et al., 2008).

Benefits

Defining the presence and severity of degenerative joint disease. Diagnosis of a fracture, calcific tendinitis, erosive lesions, or otherwise latent medical condition(s) to assist with narrowing the differential diagnosis.

Harms

Medicalization or worsening of otherwise benign shoulder condition; minor radiation exposure.

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient with two to three views. For patients with chronic shoulder pain, it may be reasonable to obtain a second set of x-rays later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

X-rays are helpful to evaluate most patients with shoulder pain, both to diagnose and to assist with the differential diagnostic possibilities such as arthroses. X-rays are particularly helpful for diagnosis of calcific tendinitis, which results in different treatment options. Glenohumeral arthrosis is also more likely if there is a full-thickness rotator cuff tear (Gartsman et al., 1997). Plain radiographic findings are used to stage disease involvement in osteonecrosis or humeral avascular necrosis. X-rays are non-invasive, low to moderate costly, and have little risk of adverse effects, and therefore are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Roentgenograms, X-Rays; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 1,148 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 1,148 articles, 1,530 in Scopus, 3 in CINAHL, 5 in Cochrane Library, 15,800 in Google Scholar, and 1 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 4 articles considered for inclusion, 3 diagnostic studies and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.4. SHOULDER ARTHROSCOPY

Arthroscopy has been used for diagnosis and as part of a therapeutic surgical treatment (58,141,142,143,144,145,579,580,581,582,583,584).

DIAGNOSTIC ARTHROSCOPIC SURGERY FOR OSTEOARTHROSIS

Not Recommended

Diagnostic arthroscopy is not recommended for diagnostic evaluation of patients with osteoarthrosis. However, there are other indications for arthroscopy.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

Arthroscopy is performed nearly universally in a context of a pre-operative diagnosis that is believed to be a treatable abnormality, rather than merely for diagnostic purposes (Dinnes et al., 2003, Fouse et al., 2007, Abrams, 2006, Baker et al., 2003, Ahmad et al., 2004, Boszotta et al., 2004). There is no arthroscopic treatment shown to be effective for osteoarthrosis; thus, arthroscopy for osteoarthrosis is not recommended. However, there are other indications for arthroscopy (e.g., significant labral tear).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Shoulder Arthroscopy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 305 articles in PubMed using

Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 305 articles, 4,956 in Scopus, 1 in CINAHL, 183 in Cochrane Library, 30,200 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 3 from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 4 diagnostic studies and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.5. BONE SCANS

Bone scans involve intravenous administration of Technetium Tc-99m that is preferentially concentrated in areas of metabolic activity (turnover) in bone. The radioactivity is then detected by a large sensor and converted into skeletal images showing the increased uptake. There are many causes for abnormal radioactive uptake; thus, positive bone scans are not highly specific (585,586,587,588).

BONE SCANNING FOR SELECT USE IN ACUTE, SUBACUTE, OR CHRONIC PAIN AND OSTEOARTHROSIS

Sometimes Recommended

Bone scanning is selectively recommended for evaluation of patients with osteoarthrosis, particularly where there is more than one joint to be evaluated in patients with acute, subacute, or chronic pain to assist in the diagnosis of osteonecrosis or other conditions with increased bone metabolism.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Shoulder pain with suspicion of osteonecrosis or other increased polyostotic bone metabolism in multiple joints and bones or acromioclavicular joint pain. This includes suspicion of multiple myeloma, metastases, infection, inflammatory arthropathies, fracture, or other significant bone trauma.

Benefits

Diagnosis of osteonecrosis, multiple myeloma, metastases, infection, inflammatory arthropathies, fracture, other significant bone trauma, or other increased polyostotic bone metabolism in multiple joints and bones or acromioclavicular joint pain.

Harms

Some radiation exposure.

Frequency/Dose/Duration

Obtaining bone scans once is generally sufficient. For rare patients with chronic shoulder pain, or a disorder with a need to track activity (e.g., cancer), it may be reasonable to obtain a subsequent bone scan to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

Bone scanning may be a helpful diagnostic test to evaluate suspected metastases (multiple sites), infected bone (osteomyelitis), inflammatory arthropathies, and trauma (e.g., occult fractures), particularly if MRI is not available or is contraindicated. It may be helpful in those with suspected, early osteonecrosis (avascular necrosis) without x-ray changes. In cases where the diagnosis is felt to be secure, there is no indication for bone scanning as it does not alter the treatment or management. Bone scanning is minimally invasive, has minimal potential for adverse effects (essentially equivalent to a blood test), but is high cost.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Bone Scan, bone scintigraphy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 57 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 57 articles, 1,640 in Scopus, 0 in CINAHL, 458 in Cochrane Library, 5,580 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 diagnostic study and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.6. COMPUTED TOMOGRAPHY (CT)

Computerized tomography remains an important imaging procedure, particularly for bony anatomy, whereas MRI is superior for soft tissue abnormalities. However, most shoulder pain patients have issues with soft tissue rather than bony abnormalities in the shoulder (589,590); thus, on a population-basis, far fewer CT scans are ordered. CT may nevertheless be useful for shoulder joint abnormalities where advanced imaging of the bones is required (i.e., complex proximal humerus fracture, scapular fracture). CT also may be useful to evaluate the anatomy in patients with contraindications for MRI (most typically an implanted metallic-ferrous device). CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – glenoid deficiency and humeral Hill-Sachs – as MRI is not as good for bone imaging. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear.

COMPUTED TOMOGRAPHY (CT) FOR EVALUATION OF OSTEOARTHROSIS

Not Recommended

Computerized tomography is not recommended for the evaluation of osteoarthrosis. There are other indications for CT.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

CT is particularly used to evaluate osseous structures; however, x-rays suffice for the vast majority of patients with osteoarthrosis and it is thus not recommended. There are other indications for CT, including preoperative planning (Scalise et al., 2008).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Computerized Tomography, CT; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 300 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 300 articles, 2,423 in Scopus, 68 in CINAHL, 1,420 in Cochrane Library, 20,000 in Google Scholar, and 0from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 2 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.7. HELICAL CT

HELICAL CT FOR EVALUATION OF OSTEOARTHROSIS

Not Recommended

Helical CT is not recommended for the evaluation of osteoarthrosis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There is no quality evidence that helical CT scans help in the diagnosis of shoulder osteoarthrosis and thus they are not recommended. There are other indications for helical CT scans.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Helical CT Scans, tomography, spiral computed tomography; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative

predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 3 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 0 articles, 60 in Scopus 0 in CINAHL, 1 in Cochrane Library, 2,910 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 2 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.8. LOCAL ANESTHETIC INJECTIONS

Diagnostic injections particularly of the subacromial space, glenohumeral joint and acromioclavicular joint are sometimes performed. However, they are nearly always performed in combination with a therapeutic intervention, such as a glucocorticosteroid injection. Injection with a therapeutic agent is nearly always preferable due to less overall invasiveness with 1 injection rather than 2, as well as the potential to assess the patient both immediately post-injection for diagnostic purposes as well as longer term for therapeutic purposes.

See Rotator Cuff Tendinopathy Injections.

6.5.9. FUNCTIONAL CAPACITY EVALUATIONS

FUNCTIONAL CAPACITY EVALUATIONS FOR CHRONIC DISABLING SHOULDER PAIN

Recommended

Functional capacity evaluations (FCEs) are recommended as an option for evaluation of disabling chronic shoulder pain where the information may be helpful to attempt to objectify worker capability, function, motivation, and effort vis-à-vis either a specific job or general job requirements. There are circumstances where a patient is not progressing as anticipated at 6 to 8 weeks and an FCE may help evaluate functional status and patient performance in order to match performance to specific job demands, particularly in instances where those demands are medium to heavy. If a provider is comfortable describing work ability without an FCE, there is no requirement to do this testing. Recordings or observation for signs of mismatch between effort and self-reported abilities may be particularly helpful.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Patients with moderate to severe chronic shoulder pain that has ongoing functional impairments and need to attempt to identify and quantify limitations. There are circumstances where a patient is not progressing as anticipated at 6 to 8 weeks and an FCE can evaluate functional status and patient performance in order to match performance to specific job demands, particularly in instances where those demands are medium to heavy. More typically, FCEs are useful after a healing plateau is

established whether surgery was performed or not. If a provider is comfortable describing work ability without an FCE, there is no requirement to do this testing. Recordings or observation for signs of mismatch between effort and self-reported abilities may be particularly helpful.

Benefits

Identification and enumeration of limitations. Assess functional abilities and may facilitate greater confidence in return to work.

Harms

Inappropriately low estimates of abilities, self-limitation of efforts, excessive disability, inappropriately precluding the performance of tasks and activities the person could safely perform. Medicalization, worsening of shoulder pain with testing; may have misleading results that understate capabilities.

Frequency/Dose/Duration

Generally, only one test is needed. A repeat FCE may be needed if there are substantial changes in the person's condition or status, or if there is a need to assess projected performance against a different set of job criteria.

Rationale

There are no quality studies of FCEs to evaluate ability to perform work and/or work limitations. Yet, FCEs are one of the few means to attempt to objectify limitations and are frequently used in workers' compensation systems, particularly as the correlation between clinical pain ratings and functional abilities appears weak (Brouwer et al., 2005, Gross et al., 2003, Reneman et al., 2002, Reneman et al., 2007, Schiphorst Preuper et al., 2008, Smeets et al., 2007, Eriksen et al., 2006). However, obtaining objective data regarding shoulder problems is somewhat more challenging than for distal upper extremity-related impairments due to the degree of reliance on the patient's subjective willingness to exert or sustain major activities that are critical for job performance. Because their reliability and validity have not been proven, FCEs should be utilized to evaluate work ability about what a patient was willing to do on a given day. They should be carefully performed and interpreted, but FCEs should not be used to override the judgment about the work ability of a patient with a shoulder problem.

Many commercial FCE models are available. There is research regarding inter-and intra-rater reliability for some of the models (complete discussion is beyond the scope of this guideline). The validity of FCEs, particularly predictive validity, is more difficult to determine, since factors other than physical performance may affect return to work (Pransky et al., 2004, Gouttebarge et al., 2004). An FCE may be done for one or more reasons, including identifying an individual's ability to perform specific job tasks associated with a job (job-specific FCE) and physical activities associated with any job (general FCE), or to assist in the objectification of the degree(s) of impairment(s). The type of FCE needed, and any other issues the FCE evaluator needs to address, should be specified when requesting an FCE.

The term "capacity" used in FCE may be misleading, since an FCE generally measures an individual's voluntary performance rather than his or her capacity. Physical performance is affected by psychosocial as well as physical factors. The extent of an individual's performance should be evaluated as part of the FCE process through analysis of his or her level of physical effort (based on physiological and biomechanical changes during activity) and consistency of performance. Perhaps more

importantly, the objective findings identified in the musculoskeletal evaluation should correlate with any identified functional deficits. The individual's performance level, especially as it relates to stated levels of performance, should be discussed in the FCE report. A properly performed and well-reported FCE will highlight such discrepancies. This is particularly important in shoulder evaluations where there may be greater degrees of impairments at stake and where there are somewhat fewer metrics available than for the distal upper extremity.

FCE test components may vary depending on the model used, but most contain the following:

- Patient interview including: informed consent, injury/illness and medical history, current symptoms, activities and stated limitations, pain ratings/disability questionnaires
- Musculoskeletal examination (e.g., including analogues of Waddell's non-organic signs for the shoulder such as non-anatomic pain)
- Observations throughout the session (e.g., demonstrated sitting tolerance, pain modifying behaviors)
- Material handling tests (lifting, carrying, pushing, pulling)
- Movement tests (walking, crouching, kneeling, reaching, etc.)
- Positional tolerance tests
- Dexterity/hand function
- Static strength (varies among models)
- Aerobic fitness (usually submaximal test-also variable among models)
- Job-specific activities as relevant
- Reliability of client reporting (e.g., non-organic signs, pain questionnaires, placebo tests, etc.)
- Physical effort testing (e.g., Jamar Dynamometer maximum voluntary effort, bell curve analysis, rapid exchange grip, competitive test performance, heart rate, observation of clinical inconsistencies, etc.)

FCE test length may vary between FCE models, although most 1-day FCEs are completed in 3 to 4 hours. Two-day tests, where the patient is seen on 2 consecutive days, may be recommended when there are problems with fatigue (e.g., chronic fatigue syndrome), delayed onset of symptoms, unusually complex job demands to simulate, and questions about symptom validity. Test length for 2-day tests is generally 3 to 4 hours on the first day, and 2 to 3 hours on the second day.

Interpretation of FCE results is complicated in that it is a measure of voluntary performance. Before beginning testing, the patient is counseled to avoid doing anything to knowingly reinjure him or herself. Thus, "fear avoidance" may cause testing to seriously underestimate actual ability and result in a report that the patient had "self-limited performance due to pain," suggesting a low pain tolerance, when in reality the patient was doing what he or she was instructed.

By analogy, the best studies on the ability of FCEs to predict safe re-entry to the workplace following rehabilitation of work-related back pain/injury suggest that FCEs are not able to predict safe return to work (concurrent validity) (Gross et al., 2005, Gross et al., 2004, Gross et al., 2004). In a prospective cohort study of 1,438 consecutive work-related back patients, all underwent an FCE prior to return to work. In the control group, the FCE was used to write return-to-work guidelines, while in the study group it was ignored and the worker was returned usually to full duty. Ignoring the FCE improved outcome (Hall et al., 1994).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Functional Capacity Evaluations; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 6 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 34 articles, 42 in Scopus, 8,289 in CINAHL, 11 in Cochrane Library, 334 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.10. MAGNETIC RESONANCE IMAGING (MRI)

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for many shoulder joint problems since it tends to be helpful for imaging soft tissues, particularly the rotator cuff (591,592,184,593,594,595,57,596,597,598,599,600,601,602,603,604,605,606,607,608,609,610,611,612,613,614).

MAGNETIC RESONANCE IMAGING (MRI) FOR EVALUATION OF OSTEOARTHROSIS

Not Recommended

Magnetic resonance imaging (MRI) is not recommended for the evaluation of osteoarthrosis of either the glenohumeral or acromioclavicular joint. There are other indications for MRI.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

MRI is particularly used to evaluate soft tissue. X-rays suffice for the vast majority of patients with osteoarthrosis. There is no quality evidence that MRI adds diagnostic value to that of x-ray for osteoarthrosis. Thus, MRI is not recommended. There are other indications for MRI.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnetic Resonance Imaging, MRI; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint;

diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 208 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 208 articles, 2,682 in Scopus, 1 in CINAHL, 1 in Cochrane Library, 28,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 7 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 9 articles considered for inclusion, 8 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.11. ARTHROGRAPHY

Arthrography involves the injection of contrast into the joint. It was modified in the 1970s to include injection of air ("double contrast") (131). Arthrography under fluoroscopy in isolation has now been almost entirely replaced by other procedures, including MRI and MR arthrography, primarily due to its low sensitivity for full-thickness tears and essentially no sensitivity for partial-thickness tears (199). Most arthrograms including MR arthrogram and CT arthrogram are performed using fluoroscopy to localize the joint and inject the contrast agent (615,616,617).

ARTHROGRAPHY FOR EVALUATION OF OSTEOARTHROSIS

Not Recommended

Arthrography is not recommended for the evaluation of shoulder osteoarthrosis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There is no quality evidence of the utility of arthrography for diagnosing osteoarthrosis and thus it is not recommended as a standalone diagnostic procedure. However, there are indications for arthrography combined with advanced imaging (e.g., MRA).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Arthrography; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 77 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 77 articles, 1,433 in Scopus, 0 in CINAHL, 164 in Cochrane Library, 9,290 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 1 diagnostic study and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.12. MAGNETIC RESONANCE ARTHROGRAM (MRA)

Magnetic resonance (MR) arthrography combines an MRI with an arthrogram to overcome limitations of each test and is usually performed in preference to CT arthrography unless bony structure definition is needed as well (173,174). MR arthrography is particularly thought to be effective for imaging labral pathology (175,176,177,178,179,180,43,181,618,619).

MAGNETIC RESONANCE ARTHROGRAPHY (MRA) FOR EVALUATING OSTEOARTHROSIS

Not Recommended

Magnetic resonance arthrography (MRA) is not recommended for evaluating osteoarthrosis. However, there are other indications for MRA.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

Magnetic resonance arthrography is particularly used to evaluate select soft tissues such as labral tears. X-rays suffice for most patients with osteoarthrosis and thus MRA is not recommended. There are other indications for MRA.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnetic Resonance Arthrogram; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 30 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 30 articles, 58 in Scopus, 0 in CINAHL, 2 in Cochrane Library, 6,670 in Google Scholar, and 2 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 2 from other sources. Of the 4 articles considered for inclusion, 4 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.13. ULTRASOUND

Diagnostic ultrasound has been used for evaluating rotator cuff tears (184,185,186,187,188,189) and has been attempted for diagnosis of shoulder arthritis (620).

ULTRASOUND FOR DIAGNOSING OSTEOARTHROSIS

Not Recommended

Ultrasound is not recommended for evaluating osteoarthrosis. There are other indications for ultrasound.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

X-rays suffice for most patients with osteoarthrosis and thus ultrasound is not recommended. There are other indications for ultrasound.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasound, Ultrasonography, Ultrasonics, Doppler Ultrasonography; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 1,115 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 1,115 articles, 3246 in Scopus, 2 in CINAHL, 16,218 in Cochrane Library, 25,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.14. SINGLE PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

Single-photon emission computed tomography (SPECT) is a 3-dimensional imaging technique that has been useful in diagnosing osteoarthritis of the knee. It has been used to diagnose osteoarthritis of the shoulder (621).

SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT) FOR DIAGNOSING OSTEOARTHROSIS

Not Recommended

Single-proton emission computed tomography (SPECT) is not recommended for the evaluation of patients with osteoarthrosis. There are other indications for SPECT.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain including osteoarthrosis. One study suggested abnormal findings in both osteoarthrosis and bursitis and suggested the patterns of abnormalities provided diagnostic utility (Wandler et al., 2005). Another study found PET identified abnormal areas (Nguyen et al., 2018). One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning.

Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment, and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating shoulder disorders.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Single Photon Emission Computed Tomography, SPECT; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 3 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 3 articles, 32 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 3,200 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.5.15. POSITRON EMISSION TOMOGRAPHY (PET)

Positron emission tomography (PET) is an imaging test that detects changes in metabolic processes and has been used to diagnose osteoarthritis of the shoulder (622) (623).

POSITRON EMISSION TOMOGRAPHY (PET) FOR DIAGNOSING OSTEOARTHROSIS

Not Recommended

PET scanning is not recommended for the evaluation of patients with osteoarthrosis. There are other indications for PET.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain including osteoarthrosis. One study suggested abnormal findings in both osteoarthrosis and bursitis and suggested the patterns of abnormalities provided diagnostic utility (Wandler et al., 2005). Another study found PET identified abnormal areas (Nguyen et al., 2018). One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Positron Emission Tomography, PET; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 10 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 10 articles, 243 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 3,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 2 diagnostic studies and 0 systematic reviews met the inclusion criteria.†

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.6. TREATMENT RECOMMENDATIONS

6.6.1. INITIAL CARE

Initial care of a patient with osteoarthrosis involves education. Identification of accompanying disorders, such as rotator cuff tear, allows for treatment of an accompanying condition to substantially reduce or resolve the symptoms. Over-the-counter (OTC) analgesics have been used in the initial treatment of shoulder osteoarthrosis to manage pain (624,625,626,627,628,629,630,631,632,633,634,635,636,637,638,639,640,641,642,643,644).

OVER-THE-COUNTER (OTC) ANALGESICS FOR TREATMENT OF OSTEOARTHROSIS

Recommended

Over-the-counter analgesics are recommended for treatment of osteoarthrosis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Shoulder osteoarthrosis

Benefits

Self-management of the pain

Harms

Negligible for OTC analgesics unless acetaminophen doses exceed 3.5g, or the patient has liver disease or another condition

Frequency/Dose/Duration

Per manufacturer's recommendations

Indications for Discontinuation

Resolution of pain, lack of efficacy, intolerance, complication

Rationale

There are no quality trials evaluating analgesics for managing shoulder osteoarthrosis. However, analgesics and OTC NSAIDs are likely helpful and there is some quality evidence for the use of prescription NSAIDs for other shoulder nociceptive pain (see NSAIDs for rotator cuff tendinopathy); thus, they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: aspirin, naproxen, paracetamol, diclofenac potassium, capsaicin, salicylates, lidocaine, diclofenac, dexketoprofen, over the counter analgesic drugs, non-prescription analgesics, NSAIDs; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 9 articles in PubMed, 3,674 in Scopus, 1 in CINAHL, 0 in Cochrane Library, 21,300 in Google Scholar, and 1 from other sources†. We considered for inclusion 2 from PubMed, 15 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of

the 18 articles considered for inclusion, 2 randomized trials and 11 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SELF-APPLICATION OF HEAT FOR TREATMENT OF OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the self-application of heat for treatment of shoulder osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials evaluating heat or ice. Ice and heat applications do not appear to materially affect a deep joint such as the shoulder, although a recommendation for self-applications is not unreasonable. Thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Heat, Ice; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 27 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 28,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SELF-APPLICATION OF ICE FOR TREATMENT OF OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the self-application of ice for treatment of shoulder osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials evaluating heat or ice. Ice and heat applications do not appear to materially affect a deep joint such as the shoulder, although a recommendation for self-applications is not unreasonable. Thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Heat, Ice; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 27 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 28,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.6.2. ACTIVITY MODIFICATION AND EXERCISE

EXERCISE FOR THE TREATMENT OF SHOULDER OSTEOARTHROSIS

Recommended

See the exercise recommendations for rotator cuff tendinopathy.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence regarding the efficacy of exercise for treatment of shoulder osteoarthrosis. There is quality evidence of efficacy regarding knee and hip osteoarthrosis, which have indicated efficacy particularly of weight-bearing aerobic exercise and strengthening exercises. Thus, there is a low threshold for use of exercise for treatment of shoulder osteoarthrosis. Exercise is believed to be quite important for surgical rehabilitation. Based on lack of quality data for shoulder osteoarthrosis (Guo, 2016), the guidance for rotator cuff tendinopathy is advised to be used for shoulder osteoarthrosis patients.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: exercise, exercise therapy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials,

random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 7 articles in PubMed, 7,696 in Scopus, 0 in CINAHL, 15 in Cochrane Library, 44,700 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.6.3. MEDICATIONS

Over-the-counter medications may be helpful to manage pain. These especially include acetaminophen and NSAIDs (645,646). NSAIDs show greater efficacy, but overall acetaminophen has a greater safety profile. Generally, the only medications commonly used for osteoarthrosis patients are NSAIDs, but patients may require other medications post-operatively. Select patients may require the judicious use of opioids for pain management. Other medications that have been used to treat osteoarthrosis include glucosamine, chondroitin, and methylsulfonylmethane. Topical agents, such as capsaicin, have also been utilized.

In the absence of quality evidence, it is recommended that the use of medications for shoulder osteoarthrosis be managed according to the following recommendations for Rotator Cuff Tendinopathy and Knee Osteoarthrosis:

- NSAIDs for Treatment of Rotator Cuff Tendinopathies and Shoulder Pain *[Strongly Recommended, Evidence (A)]*
- Acetaminophen for Acute, Subacute, or Chronic Shoulder Pain *[Recommended, Insufficient Evidence (I)]*
- Acetaminophen for Perioperative or Postoperative Shoulder Pain *[Recommended, Evidence (C)]*
- Muscle Relaxants for for Acute or Subacute Shoulder Pain *[Recommended, Insufficient Evidence (I)]*
- Norepinephrine Reuptake Inhibiting Anti-depressants for Subacute or Chronic Shoulder Girdle Pain *[Recommended, Insufficient Evidence (I)]*
- Selective Serotonin Reuptake Inhibitors for Acute, Subacute, or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Anti-convulsants for Acute, Subacute or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Oral Glucocorticosteroids for Acute, Subacute, or Chronic Shoulder Pain or Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Capsicum Creams for Acute, Subacute, Chronic Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*
- Topical Glyceryl Trinitrate, Lidocaine Patches, Eutectic Mixture of Local Anesthetics (EMLA), and Other Creams/Ointments for Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*

- Tumor Necrosis Factor-alpha Blockers for Osteoarthrosis or Acute, Subacute, or Chronic Knee Pain or Other Non-inflammatory Knee Disorders *[Not Recommended, Insufficient Evidence (I)]*
- Glucosamine Sulfate, Chondroitin Sulfate, or Methylsulfonylmethane for Knee Osteoarthrosis *[No Recommendation, Insufficient Evidence (I)]*

See also the ACOEM Opioids Guideline for recommendations and evidence on the treatment of subacute and chronic pain.

Regarding alternative medicine, there are no recommendations for or against use of the following for the treatment of acute, subacute, or chronic knee pain that may be generalized to the shoulder: Willow bark (Salix), ginger extract, rose hips, camphora molmol, maleluca alternifolia, angelica sinensis, aloe vera, thymus officinalis, menthe peperita, arnica montana, curcuma longa, tancaetum parthenium, and zingiber officinicalis, avocado soybean unsaponifiables, oral enzymes, topical copper salicylate, S-Adenosylmethionine, or diacerein harpagoside.

6.6.4. DEVICES

Slings generally promote debility in osteoarthrosis and are believed to predispose towards adhesive capsulitis; thus, they are not recommended to treat shoulder OA. However, the use of slings and functional braces is frequently needed in the postoperative setting (374,647).

SLINGS AND BRACES FOR TREATMENT OF OSTEOARTHROSIS

Not Recommended

Slings and braces are not recommended for the treatment of osteoarthrosis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

There are no quality trials evaluating slings and braces for managing non-operative osteoarthrosis. There are trials in post-arthroplasty patients (Baumgarten et al., 2018). However, slings and braces are not recommended as they promote debility, which is thought to substantially increase the risk for adhesive capsulitis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Slings, Braces; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 7 articles in PubMed, 819 in Scopus, 0 in CINAHL, 5 in Cochrane Library, 2,320 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 1 randomized trial and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms.

Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MAGNETS AND MAGNETIC STIMULATION FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

Not Recommended

Magnets and magnetic stimulation are not recommended for treatment of shoulder osteoarthrosis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

There are no quality studies for the treatment of shoulder osteoarthrosis. Magnets and magnetic stimulation have been evaluated in quality trials for other MSDs, including LBP and found to be ineffective; thus, they are not recommended for treatment of shoulder osteoarthrosis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnets, Magnetic Stimulation, Magnetics, Magnetic Field Therapy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 83 articles in PubMed, 127 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 17,700 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TAPING FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

Not Recommended

Taping is not recommended for treatment of shoulder osteoarthrosis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies for the treatment of shoulder osteoarthrosis. Taping has been evaluated in quality trials for other MSDs, including LBP and found to be ineffective; thus, it is not recommended for treatment of shoulder osteoarthrosis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: athletic tape, kinesiology taping, taping, osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed articles in 1 PubMed, 521 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 0 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.6.5. ALLIED HEALTH INTERVENTIONS

Acupuncture has been used for treatment of patients with chronic shoulder osteoarthrosis (648,649). It has most commonly been used as an adjunct to more efficacious treatments.

Manual therapy, mobilization, manipulation, and massage have been used to treat patients with osteoarthrosis (650,651,652). Manual therapy has been used to treat osteoarthrosis of the knee and hip, as well as the shoulder (653,654,655). Massage has been used to treat glenohumeral osteoarthrosis (656,215,657,658). Mobilization has also been used to treat osteoarthrosis (659).

Various means of delivering heat and electrical therapies for purposes of distraction have been utilized for treatment of osteoarthrosis, although no quality studies for treatment of shoulder osteoarthrosis have been identified, including diathermy (660,661,662,663), infrared therapy (664), ultrasound (567,665), laser therapy (666,667), transcutaneous nerve stimulation (TENS)(668,669), taping (670), magnetic stimulation (671), and pulsed electromagnetic frequency devices (672).

ACUPUNCTURE FOR TREATMENT OF SELECT PATIENTS WITH CHRONIC OR POST-OPERATIVE OSTEOARTHROSIS

Sometimes Recommended

Acupuncture is recommended for select use in chronic shoulder pain or postoperative pain only as an adjunct to more efficacious treatments.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

As a tertiary treatment if NSAIDs, active exercises, injections, and surgery (if indicated) fail to resolve or sufficiently improve pain.

Benefits

Modest reduction in pain.

Harms

Rare needling of deep tissue, such as artery, lung, etc. and resultant complications. Use of acupuncture may theoretically increase reliance on passive modality(ies) for chronic pain.

Frequency/Dose/Duration

Frequency and duration pattern in the quality trial was weekly for 8 weeks. An initial trial of 4 appointments would appear reasonable in combination with a conditioning program of aerobic and strengthening exercises. An additional 4 appointments should be tied to partial incremental functional improvements in objective measures, for a total of 8. If acupuncture is trialed in a patient, objective functional improvement should be demonstrated after 6 visits.

Indications for Discontinuation

No functional gains demonstrated, resolution, intolerance, non-compliance including non-compliance with aerobic and strengthening exercises.

Rationale

The overall body of evidence for the use of acupuncture for the shoulder is relatively weak. There is one moderate-quality trial that included patients with shoulder osteoarthrosis, along with multiple other conditions, with some indication of efficacy of acupuncture (Moore et al., 1976). There are multiple other trials involving chronic shoulder conditions including rotator cuff tendinopathies with quality evidence suggesting some modest efficacy (see Rotator Cuff Tendinopathies). Acupuncture is minimally invasive as typically performed, has low adverse effects, is moderately costly depending on numbers of treatments, and is recommended for select use in patients in whom other interventions, particularly if NSAIDs and activity modifications are insufficient. Acupuncture is recommended to assist in increasing functional activity levels more rapidly; the primary attention should remain on the exercise program and document functional gain. In those not involved in an exercise program, or who are non-compliant with graded increases in activity levels, this intervention is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Acupuncture, acupuncture therapy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 24 articles in PubMed, 1,668 in Scopus, 0 in CINAHL, 5,643 in Cochrane Library, 1,340 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0

from Google Scholar, and 1 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANUAL THERAPY FOR TREATMENT OF OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of manual therapy for patients with osteoarthrosis of the shoulder. There are other indications for this treatment.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of manual therapy for patients with OA; thus, there is no recommendation for or against its use.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Manual Therapy, Musculoskeletal Manipulation; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 17 articles in PubMed, 1,425 in Scopus, 0 in CINAHL, 4 in Cochrane Library, 18,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 3 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 0 randomized trials and 4 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MASSAGE FOR TREATMENT OF OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of massage for patients with osteoarthrosis of the shoulder. There are other indications for this treatment.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of massage for patients with OA; thus, there is no recommendation for or against its use.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Massage, Massage Therapy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 8 in Scopus, 0 in CINAHL, in 822 Cochrane Library, 14,200 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 2 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 0 randomized trials and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANIPULATION OR MOBILIZATION FOR TREATMENT OF OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of manipulation or mobilization for patients with osteoarthrosis of the shoulder. There are other indications for these treatments.

Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of manipulation or mobilization for patients with OA; thus, there is no recommendation for or against their use.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Manipulation; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 15 articles in PubMed, 513 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 25,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Mobilization, Joint Mobilization; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 28 articles in PubMed, 2,118 in Scopus, 0 in CINAHL, 2,841 in Cochrane Library, 16,700 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PERCUTANEOUS ELECTRICAL NERVE STIMULATION (PENS) FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of percutaneous electrical nerve stimulation (PENS) for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of PENS for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: percutaneous electrical nerve stimulation, PENS; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 11 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 3,040 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search,

and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SYMPATHETIC ELECTROTHERAPY FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of sympathetic electrotherapy for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of sympathetic electrotherapy for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Sympathetic electrotherapy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 742 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

IONTOPHORESIS FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of iontophoresis for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of iontophoresis for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Iontophoresis; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 57 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 1,650 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

HIGH-VOLTAGE GALVANIC STIMULATION FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of high-voltage galvanic stimulation for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of high-voltage galvanic stimulation for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: High-voltage galvanic stimulation; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0articles in PubMed, 2 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 188 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MICROCURRENT STIMULATION FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of microcurrent stimulation for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of microcurrent stimulation for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: microcurrent; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 8 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 365 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INTERFERENTIAL THERAPY FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of interferential therapy for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of interferential therapy for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Interferential Therapy;

osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 23 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 1,300 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INFRARED THERAPY FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of infrared therapy for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of infrared therapy for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Infrared Therapy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 501 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 16,300 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

LASER THERAPY FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of laser therapy for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of laser therapy for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Laser Therapy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 42 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 13,100 in Google Scholar, and 5 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

DIATHERMY FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of diathermy, for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of diathermy for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Diathermy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 1 article in PubMed, 53 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 2,070 in Google Scholar, and 0 from other sources†. We considered for inclusion 0

from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ULTRASOUND FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of ultrasound for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of ultrasound for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasound, Ultrasonography; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 469 articles in PubMed, 5,154 in Scopus, 2 in CINAHL, 11 in Cochrane Library, 29,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TRANSCUTANEOUS ELECTRICAL STIMULATION (TENS) FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of transcutaneous electrical stimulation (TENS) for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)

Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of TENS for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Electrical Therapy, Electrical Stimulation Therapy, Transcutaneous Electric Nerve Stimulation; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 6 articles in PubMed, 1,841 in Scopus, 0 in CINAHL, 3 in Cochrane Library, 7,520 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

H-WAVE® DEVICE STIMULATION FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against the use of H-wave® Device Stimulation for the treatment of shoulder joint osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of H-wave® Device Stimulation for patients with OA; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: H-wave stimulation; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective,

prospective studies. We found and reviewed 0 articles in PubMed, 2 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 110 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PULSED ELECTROMAGNETIC FREQUENCY FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

Not Recommended

Pulsed electromagnetic frequency is not recommended for treatment of shoulder osteoarthrosis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies for the treatment of shoulder osteoarthrosis. Pulsed electromagnetic frequency has been evaluated in quality trials for other MSDs, including LBP and found to be ineffective and thus is not recommended for treatment of shoulder osteoarthrosis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Pulsed Electromagnetic Frequency, Low Field Magnetic Stimulation; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 874 in Scopus, 0 in CINAHL, 281 in Cochrane Library, 30 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.6.6. INJECTION THERAPIES

Intra-articular glucocorticosteroid injections are sometimes performed to attempt to deliver medication with minimal systemic effects to the shoulder joints, especially the glenohumeral joint and sometimes the acromioclavicular joint (673) (674). These injections are both performed with and without fluoroscopic or ultrasound guidance. Their usual purpose is to gain sufficient relief to either resume conservative medical management or to delay surgical intervention. There is quality evidence of short-term efficacy in treatment of hip and knee osteoarthrosis patients (see Knee Disorders), with duration of benefits of approximately 3 months.

Viscosupplementation has been performed particularly for knee osteoarthrosis and hip osteoarthrosis (675) (676) (677) (678) (679). These injections have been performed in the shoulder as well (680) (681) (682) (683) (684) (685) (686) (687).

Platelet-rich plasma injections have been used to treat shoulder osteoarthrosis (688) (689). Prolotherapy injections have been utilized to treat a wide array of musculoskeletal disorders, including shoulder osteoarthrosis (690).

INTRA-ARTICULAR GLUCOCORTICOSTEROID INJECTIONS FOR SHOULDER GLENOHUMERAL OR ACROMIOCLAVICULAR JOINT OSTEOARTHROSIS

Recommended

Glucocorticosteroid injections are moderately recommended for treatment of osteoarthrosis of the glenohumeral or AC joint.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Glenohumeral or acromioclavicular joint pain from osteoarthrosis sufficient that control with NSAIDs, acetaminophen, and potentially exercise is unsatisfactory. There should be understanding that the anticipated duration of benefit is 3 months based on inference from many quality trials of hip injections.

Benefits

Short to intermediate-term improved pain.

Harms

Steroid flare after an injection; glucose elevation, rare infection, rare nerve injury. Theoretical weakening of cuff tendons and potentially delayed surgical healing.

Frequency/Dose/Duration

Schedule one injection and monitor the patient over the next 4-6 weeks with follow-up assessments of pain, function and ADLs. A series of 3 injections should not be a priori scheduled. There are no quality studies assessing frequency/dose in glenohumeral or AC joints. Medications used in the RCTs for the comparably-sized hip joint were triamcinolone hexacetonide 40mg or triamcinolone acetonide 80mg, or methylprednisolone 40 or 80mg. Anesthetics have most often been bupivacaine or mepivacaine. There are no head to head comparisons in quality studies of different medications to ascertain the optimum medication(s). Multiple doses have been utilized with no head-to-head comparisons in trials; however, a comparative clinical trial found greater efficacy for methylprednisolone 80mg over 40mg in treatment of hip osteoarthrosis (Robinson et al., 2007).

Indications for Discontinuation

A second glucocorticosteroid injection is not recommended if the first has typically resulted in at least 50% reduction in pain, significant improvement in function (e.g., achieving at least 50% improvement, return to normal function, return to usual work) or resolution of symptoms. If there has not been a response to a first injection, there is generally less indication for a second. If the interventionalist believes the medication was not well placed and/or if the underlying condition is so severe that 1 steroid bolus could not be expected to adequately treat the condition, a second injection may be indicated and should be performed under ultrasound or fluoroscopic guidance. In patients who respond with a pharmacologically appropriate several weeks of temporary, partial relief of pain, but who then have worsening pain and function and who are not (yet) interested in surgical intervention, a repeat steroid injection is an option. There are not believed to be benefits beyond approximately 3 of these injections in a year. Patients requesting a fourth injection should have reassessment of conservative management measures and be counseled for possible surgical intervention.

Rationale

There are no quality trials evaluating intra-articular glucocorticosteroid injections for treatment of shoulder joint OA. However, there are many quality trials for treatment of both hip and knee osteoarthrosis patients with documented efficacy lasting approximately 3 months compared with placebo. These injections are invasive, have a low risk of adverse effects, but are relatively costly. They are an option for treatment of moderate to severe shoulder osteoarthrosis patients particularly after inadequate results from NSAID trials, activity modification, exercise, or other conservative interventions.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Intra-articular Glucocorticosteroid Injections, Intra-articular Corticosteroid Injections; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 18 articles in PubMed, 7 in Scopus, 0 in CINAHL, 10 in Cochrane Library, 2,090 in Google Scholar, and 0 from other sources.† We considered for inclusion 3 from PubMed, 0 from Scopus,0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INTRAARTICULAR VISCOSUPPLEMENTATION INJECTIONS FOR SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against intraarticular shoulder viscosupplementation injection for treatment of osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are 4 moderate-quality trials that included shoulder osteoarthrosis patients. One suggested efficacy (Di Giacomo et al., 2017), while the other 3 suggest inefficacy (Blaine et al., 2008) (Kwon et al., 2000) (Shibata et al., 2001). Some of the higher quality trials for treatment of knee and hip osteoarthrosis suggest short- to intermediate-term efficacy (see Knee Disorders Guideline). Viscosupplementation injections are invasive, have a low risk of adverse effects, but are relatively costly. A high-quality trial showed glucocorticosteroid injections are superior (Qvistgaard et al., 2006). Viscosupplementation injections do not have consistent evidence of efficacy for treatment of shoulder osteoarthrosis and are generally not recommended. As some studies of hip/knee OA suggest efficacy, the overall rating is "No Recommendation." In light of current evidence, viscosupplementation would be a last-resort consideration in a patient who has not had symptomatic relief of pain or function with glucocorticoid injections, is not a suitable candidate for surgery, and is searching for non-operative alternatives. While cost is a factor, shared decision making with the patient explaining risks and benefits as well as costs associated with the procedure, in addition to a nuanced discussion with the commercial carrier explaining patient-specific factors justifying viscosupplementation use would be reasonable.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Viscosupplementation Injections; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 8 articles in PubMed, 840 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 1,720 in Google Scholar, and 3 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 5 from Google Scholar, and 3 from other sources. Of the 10 articles considered for inclusion, 4 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PLATELET-RICH PLASMA INJECTIONS FOR SHOULDER OSTEOARTHROSIS

No Recommendation

There is no recommendation for or against intraarticular platelet-rich plasma injections for treatment of shoulder osteoarthrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials comparing PRP injections with sham or placebo for shoulder OA. Injections are invasive, have some adverse effects, are high cost and are lacking quality data against a known standard for efficacy, thus there is no recommendation. In highly select patients where all evidence-based options aside from arthroplasty have been exhausted, a PRP injection may be reasonable if it considerably alters the need for arthroplasty.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Platelet-Rich Plasma Injections, Autologous Conditioned Serum Injections, Autologous Conditioned Plasma Injections, Orthokine Therapy, Regenokine Therapy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 8 articles in PubMed, 1,651 in Scopus, 0 in CINAHL, 2 in Cochrane Library, 483 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PROLOTHERAPY INJECTIONS FOR TREATMENT OF SHOULDER OSTEOARTHROSIS AND OTHER SHOULDER DISORDERS

Not Recommended

Prolotherapy injections are not recommended for treatment of osteoarthrosis and other shoulder disorders.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There are no quality trials of prolotherapy injection for treatment of shoulder osteoarthrosis patients. These injections are invasive, have adverse effects, and are moderate to high cost; thus, in the absence of quality evidence of efficacy, they are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Prolotherapy Injections; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint;

controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 2 articles in PubMed, 429 in Scopus, 2 in CINAHL, 0 in Cochrane Library, 1,480 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.6.7. SURGICAL CONSIDERATIONS

6.6.7.1. ARTHROSCOPY AND CHONDROPLASTY

Arthroscopy is thought to have a role in glenohumeral arthrosis with purposes including diagnosis, debridement, capsular release, subacromial decompression, planning an operative approach, and synovectomy (691) (692) (693) (694) (695) (696) (697) (698) (699) (700) (701) (702) (703). It is particularly thought to be helpful for treatment of other conditions, such as SLAP tears and rotator cuff tendinopathies (693). Chondroplasty has often been performed for treatment of osteoarthrosis patients and involves abrading of the cartilage surfaces (see Knee Disorders) (696) (704) (705) (706) Arthroscopy is not generally indicated in presence of advanced glenohumeral arthritis.

ARTHROSCOPY FOR EVALUATION AND TREATMENT OF SHOULDER OSTEOARTHROSIS

Recommended

Arthroscopy is recommended for evaluation and treatment of shoulder osteoarthrosis, but only when an associated disorder is felt to be present, symptomatic, and treatable.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Shoulder joint pain from osteoarthrosis to the extent that control with NSAID(s), acetaminophen, and exercise strategies is unsatisfactory. Patients should have a treatable, significantly symptomatic associated condition (e.g., rotator cuff tendinopathy, impingement syndrome, SLAP tear), with the expectation that resolution of the associated condition will improve the patients' overall condition. Appropriate diagnostic testing of the associated condition should have been performed (e.g., injection, MRI or MRA) to confirm a treatable associated condition. Chondroplasty is not considered an indication or an indicated procedure (See below).

Benefits

Improved pain and function

Harms

Lack of improvement, reduced function, infection, adhesive capsulitis

Rationale

There are quality studies including arthroscopy, although not of shoulder osteoarthrosis. Also, the literature typically utilizes arthroscopy as the gold standard for comparison. Arthroscopy is performed nearly universally in a context of a pre-operative diagnosis, such as rotator cuff tendinopathy, that is thought to be a treatable abnormality, rather than merely for diagnostic purposes (Dinnes et al., 2003) (Fouse et al., 2007) (Abrams, 2006) (Baker et al., 2003) (Ahmad et al., 2004) (Boszotta et al., 2004). If a specific diagnosis that is treatable with arthroscopic techniques, such as rotator cuff tendinitis is not suggested by and supported by the evaluation with history, physical examination, and imaging studies, then surgical intervention is much less likely to be successful and caution should be taken in doing a purely diagnostic arthroscopy. Diagnostic arthroscopy is invasive, has adverse effects and is high cost. Thus, arthroscopy is selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: shoulder arthroscopy, arthroscopy; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 151 articles in PubMed, 8,311 in Scopus, 14 in CINAHL, 11 in Cochrane Library, 29,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 7 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 10 articles considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

CHONDROPLASTY FOR TREATMENT OF SHOULDER OSTEOARTHROSIS

Not Recommended

Chondroplasty is not recommended for treatment of shoulder osteoarthrosis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Benefits

None specified.

Harms

None specified.

Rationale

There are no quality trials evaluating arthroscopy for patients with OA of the shoulder. Chondroplasty is invasive, has adverse effects, is costly, and lacks efficacy in the knee as demonstrated by a high quality, sham-controlled trial (see Knee Disorders Guideline) (Moseley et al., 2002). Thus, chondroplasty is not recommended for treatment of shoulder osteoarthrosis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Chondroplasty; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 199 in Scopus, 1 in CINAHL, 0 in Cochrane Library, 1,180 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.6.7.2. DISTAL CLAVICLE RESECTION

Distal clavicle resection has been performed for chronic, significant acromioclavicular joint pain with either open (707) (708) (709) (710) (711) (712) (713) (714) (715) (716) (717) (718) or arthroscopic approaches (673) (709) (711) (713) (714) (719) (720) (721) (722) (723) (724) (725).

DISTAL CLAVICLE RESECTION FOR TREATMENT OF ACROMIOCLAVICULAR JOINT PAIN

No Recommendation

There is no recommendation for or against distal clavicle resection (either arthroscopic or open) for treatment of acromioclavicular joint pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Indications

Select patients with severe, chronic pain with failure of non-operative treatments including at minimum, NSAIDs, progressive strengthening exercises, injection(s) (Freedman et al., 2007). X-ray or other imaging evidence of acromioclavicular degenerative joint disease and confirmation with a local anesthetic injection relieving all or nearly all pain.

Benefits

Reduced pain and improved function

Harms

Lack of improvement, adhesive capsulitis

Rationale

There are no quality trials comparing clavicle excision to non-surgical treatment for AC arthrosis. Two trials of different approaches of distal clavicle resection suggest comparable efficacy (Charron et al., 2007) (Freedman et al., 2007). Trials have also been performed of rotator cuff tear patients with and without distal clavicle resection (Park et al., 2015) (Kim et al., 2011), and suggested some additive benefit in the larger (Kim et al., 2011) of the two studies (Park et al., 2015). As there is no quality evidence of efficacy and there are adverse effects of surgery, there is no recommendation. Resection is potentially indicated among those patients with severe, chronic pain focused on the AC joint and not sufficiently treated by non-operative treatments.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Distal Clavicle Resection; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 6 articles in PubMed, 237 in Scopus, 3 in CINAHL, 3 in Cochrane Library, 8090 in Google Scholar, and 2 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 2 from other sources. Of the 5 articles considered for inclusion, 4 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.6.7.3. SHOULDER ARTHROPLASTY AND REVERSE SHOULDER ARTHROPLASTY

Shoulder arthroplasty has been used to treat shoulder osteoarthrosis (696) (702) (1678) (1679) (1680) (1681) (1682) (1683) (1684) (1685) (1686) (1687) (1688) (1689) (1690) (1691) (1692) (1693) (1694) (1694) (1695) (1696) (1697) (1698) (1699) (1700) (1701) (1702) (1703) (1704) (1705) (1706) (1707) (1708) (1709) (1710) (1711) (1712) (1713) (1714) (1715) (1716) (1717) (1718) (1719) (1720), and glenohumeral degenerative joint disease (693) (1678) (1682) (1721) (1722) (1723) (1724) (1008) (1725) (1726) (1727) (1728) (1729) (1730) (1731) (1732) (1733) (1734) (1735) (1736) (1737) (1738) (1739) (1089) (1740).

Shoulder resurfacing and partial resurfacing procedures have also been performed (1726) (1741) (1742) (1743) (1744) (1745) (1746) (1747) (1748) (1749) (1750) (1751) (1752) (1753) (1754) (1755) (1756) (1757) (1758). A meniscal allograft and other soft tissue interposition, as well as glenoid reaming without replacement are alternative treatments when the glenoid is arthritic and total shoulder arthroplasty is contraindicated, i.e., young patients. Overall outcomes of arthroplasties have generally been good (1759).

The volume of quality literature is much less for shoulder arthroplasties than for those of the hip where there are numerous trials with durations of follow-up lasting many years. Humeral head resurfacing is thought to have advantages for younger and/or more physically active patients (1742). There is controversy as to whether a humeral hemiarthroplasty or total arthroplasty should be performed (1742) with concerns about excessive wear of the glenoid if it is not replaced (1727) (1742). It has been suggested the decision should depend on adequacy of bone, extent of articular damage, and presence of irreparable rotator cuff tears (1742) (1753).

TOTAL SHOULDER ARTHROPLASTY FOR SEVERE ARTHROSIS

Recommended

Total shoulder arthroplasty is moderately recommended for highly selective patients with severe arthrosis.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Low

Indications

Severe arthrosis with symptoms of at least 6 to 12 months that are insufficiently managed with non-operative measures (Lo et al., 2005) (Gartsman et al., 2005) and/or glucocorticosteroid injection(s). Patients with diffuse degenerative joint disease whether OA, rheumatoid arthritis, or other cause, are generally good candidates for total joint arthroplasties (Lo et al., 2005) (Gartsman et al., 2005), although some may be candidates for hemiarthroplasties (Smith et al., 1998). Hemiarthroplasties have been generally recommended for patients with massive rotator cuff tears combined with degenerative joint disease (Smith et al., 1998). However, shoulder arthroplasty is not nearly as successful, on average, as hip or knee arthroplasty.

Post-operative rehabilitation is required. Yet, there are no quality trials and a systematic review concluded “Published rehabilitation strategies following TSA and RTSA…(have) little consistency among protocols. There is a need to determine optimal rehabilitation approaches post TSA and RTSA based on clinical outcomes” (Bullock et al., 2019).

Benefits

Potential for improved function

Harms

Potential for worse function, adhesive capsulitis, severe impairment, worsened pain

Indications for Discontinuation

Not applicable.

Rationale

There are no quality trials comparing arthroplasty with a quality rehabilitative protocol. There are multiple moderate quality trials comparing total vs. hemiarthroplasty (Gartsman et al., 2000) (Sandow et al., 2013) (Lo et al., 2005); different surgical approaches (Lapner P, 2020) (Kwon YW, 2019); cemented vs. uncemented and/or other components (Litchfield et al., 2011) (Romeo et al., 2020) (Wiater et al., 2020) (Boileau et al., 2002); and comparisons of various components (Lo et al., 2005). However, all 3 RCTs suggest total shoulder arthroplasty is superior or trends toward superiority over hemiarthroplasty (Gartsman et al., 2000) (Sandow et al., 2013) (Lo et al., 2005). These trials document major improvements compared with pre-operative measures of pain and function among these patients (Gartsman et al., 2000) (Lo et al., 2005). There are relatively few quality trials comparing different operative approaches and sparse data address long-term outcomes. Shoulder arthroplasty is invasive, has adverse effects, and is costly. These procedures are recommended for select patients who failed multiple attempts at controlling symptoms short of arthroplasty.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Shoulder Arthroplasty, Shoulder Joint Replacement; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 619 articles in PubMed, 631 in Scopus, 32 in CINAHL, 40 in Cochrane Library, 49,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 31 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 11 from Google Scholar, and 0 from other sources. Of the 45 articles considered for inclusion, 11 randomized trials and 7 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

HEMIARTHROPLASTY FOR SEVERE ARTHROSIS

Recommended

Hemiarthroplasty is moderately recommended for highly selective patients with severe arthrosis.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Low

Indications

Severe arthrosis with symptoms of at least 6 to 12 months that are insufficiently managed with non-operative measures (Lo et al., 2005) (Gartsman et al., 2005) and/or glucocorticosteroid injection(s). Patients with diffuse degenerative joint disease whether OA, rheumatoid arthritis, or other cause, are generally good candidates for total joint arthroplasties (Lo et al., 2005) (Gartsman et al., 2005), although some may be candidates for hemiarthroplasties (Smith et al., 1998). Hemiarthroplasties have been generally recommended for patients with massive rotator cuff tears combined with degenerative joint disease (Smith et al., 1998). However, shoulder arthroplasty is not nearly as successful, on average, as hip or knee arthroplasty.

Post-operative rehabilitation is required. Yet, there are no quality trials and a systematic review concluded "Published rehabilitation strategies following TSA and RTSA…(have) little consistency among protocols. There is a need to determine optimal rehabilitation approaches post TSA and RTSA based on clinical outcomes" (Bullock et al., 2019).

Benefits

Potential for improved function

Harms

Potential for worse function, adhesive capsulitis, severe impairment, worsened pain

Rationale

There are no quality trials comparing arthroplasty with a quality rehabilitative protocol. There are multiple moderate quality trials comparing total vs. hemiarthroplasty (Gartsman et al., 2000) (Sandow et al., 2013) (Lo et al., 2005); different surgical approaches (Lapner P, 2020) (Kwon YW, 2019); cemented vs. uncemented and/or other components (Litchfield et al., 2011) (Romeo et al., 2020) (Wiater et al., 2020) (Boileau et al., 2002); and comparisons of various components (Lo et al., 2005). However, all 3 RCTs suggest total shoulder arthroplasty is superior or trends toward superiority over hemiarthroplasty (Gartsman et al., 2000) (Sandow et al., 2013) (Lo et al., 2005). These trials document major improvements compared with pre-operative measures of pain and function among these patients (Gartsman et al., 2000) (Lo et al., 2005). There are relatively few quality trials comparing different operative approaches and sparse data address long-term outcomes. Shoulder arthroplasty is invasive, has adverse effects, and is costly. These procedures are recommended for select patients who failed multiple attempts at controlling symptoms short of arthroplasty.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Shoulder Arthroplasty, Shoulder Joint Replacement; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 619 articles in PubMed, 631 in Scopus, 32 in CINAHL, 40 in Cochrane Library, 49,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 31 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 11 from Google Scholar, and 0 from other sources. Of the 45 articles considered for inclusion, 11 randomized trials and 7 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

REVERSE SHOULDER ARTHROPLASTY FOR SEVERE ARTHROSIS

Recommended

Reverse shoulder arthroplasty is moderately recommended for highly selective patients with moderate to severe arthrosis.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Low

Indications

Severe arthrosis with symptoms of at least 6 to 12 months that are insufficiently managed with non-operative measures (Lo et al., 2005) (Gartsman et al., 2005) and/or glucocorticosteroid injection(s). Patients with diffuse degenerative joint disease whether OA, rheumatoid arthritis, or other cause, are generally good candidates for total joint arthroplasties (Lo et al., 2005) (Gartsman et al., 2005), although some may be candidates for hemiarthroplasties (Smith et al., 1998). Hemiarthroplasties have been generally recommended for patients with massive rotator cuff tears combined with degenerative joint disease (Smith et al., 1998). However, shoulder arthroplasty is not nearly as successful, on average, as hip or knee arthroplasty. Post-operative rehabilitation is required. Yet, there are no quality trials and a systematic review concluded “Published rehabilitation strategies following TSA and RTSA…(have) little consistency among protocols. There is a need to determine optimal rehabilitation approaches post TSA and RTSA based on clinical outcomes” (Bullock et al., 2019).

Benefits

Potential for improved function

Harms

Potential for worse function, adhesive capsulitis, severe impairment, worsened pain

Rationale

There are no quality trials comparing arthroplasty with a quality rehabilitative protocol. There are multiple moderate quality trials comparing total vs. hemiarthroplasty (Gartsman et al., 2000) (Sandow et al., 2013) (Lo et al., 2005); different surgical approaches (Gartsman et al., 2000) (Sandow et al., 2013) (Lo et al., 2005); cemented vs. uncemented and/or other components (Litchfield et al., 2011) (Romeo et al., 2020) (Wiater et al., 2020) (Boileau et al., 2002); and comparisons of various components (Lo et al., 2005). However, all 3 RCTs suggest total shoulder arthroplasty is superior or trends toward superiority over hemiarthroplasty (Gartsman et al., 2000) (Sandow et al., 2013) (Lo et al., 2005). These trials document major improvements compared with pre-operative measures of pain and function among these patients (Gartsman et al., 2000) (Lo et al., 2005). There are relatively few quality trials comparing different operative approaches and sparse data address long-term outcomes.

Shoulder arthroplasty is invasive, has adverse effects, and is costly. These procedures are recommended for select patients who failed multiple attempts at controlling symptoms short of arthroplasty.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Shoulder Arthroplasty, Shoulder Joint Replacement; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 619 articles in PubMed, 631 in Scopus, 32 in CINAHL, 40 in Cochrane Library, 49,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 31 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 11 from Google Scholar, and 0 from other sources. Of the 45 articles considered for inclusion, 11 randomized trials and 7 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

HUMERAL RESURFACING FOR SEVERE ARTHROSIS

Recommended

Humeral resurfacing (similar to humeral head replacement) is recommended as an option.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Severe arthrosis with symptoms of at least 6 to 12 months that are insufficiently managed with non-operative measures (Lo et al., 2005) (Gartsman et al., 2005) and/or glucocorticosteroid injection(s). Patients with diffuse degenerative joint disease whether OA, rheumatoid arthritis, or other cause, are generally good candidates for total joint arthroplasties (Lo et al., 2005) (Gartsman et al., 2005), although some may be candidates for hemiarthroplasties (Smith et al., 1998). Hemiarthroplasties have been generally recommended for patients with massive rotator cuff tears combined with degenerative joint disease (Smith et al., 1998). However, shoulder arthroplasty is not nearly as successful, on average, as hip or knee arthroplasty.

Post-operative rehabilitation is required. Yet, there are no quality trials and a systematic review concluded “Published rehabilitation strategies following TSA and RTSA…(have) little consistency among protocols. There is a need to determine optimal rehabilitation approaches post TSA and RTSA based on clinical outcomes” (Bullock et al., 2019).

Benefits

Potential for improved function

Harms

Potential for worse function, adhesive capsulitis, severe impairment, worsened pain

Rationale

There are no quality trials comparing arthroplasty with a quality rehabilitative protocol. There are multiple moderate quality trials comparing total vs. hemiarthroplasty (Gartsman et al., 2000) (Sandow et al., 2013) (Lo et al., 2005); different surgical approaches (Gartsman et al., 2000) (Sandow et al., 2013) (Lo et al., 2005); cemented vs. uncemented and/or other components (Litchfield et al., 2011) (Romeo et al., 2020) (Wiater et al., 2020) (Boileau et al., 2002); and comparisons of various components (Lo et al., 2005). However, all 3 RCTs suggest total shoulder arthroplasty is superior or trends toward superiority over hemiarthroplasty (Gartsman et al., 2000) (Sandow et al., 2013) (Lo et al., 2005). These trials document major improvements compared with pre-operative measures of pain and function among these patients (Gartsman et al., 2000) (Lo et al., 2005). There are relatively few quality trials comparing different operative approaches and sparse data address long-term outcomes. Shoulder arthroplasty is invasive, has adverse effects, and is costly. These procedures are recommended for select patients who failed multiple attempts at controlling symptoms short of arthroplasty.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Shoulder Arthroplasty, Shoulder Joint Replacement; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly; systematic, systematic review, retrospective, prospective studies. We found and reviewed 619 articles in PubMed, 631 in Scopus, 32 in CINAHL, 40 in Cochrane Library, 49,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 31 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 11 from Google Scholar, and 0 from other sources. Of the 45 articles considered for inclusion, 11 randomized trials and 7 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

6.6.8. FOLLOW-UP VISITS

Patients with osteoarthrosis generally require a few follow-up appointments for purposes of monitoring symptoms, advancing treatment, and gradually reducing limitations especially if treatment of a co-existent condition substantially resolves the symptoms. Patients with more advanced disease may require a greater number of appointments to attempt other treatments as well as to teach about adaptive techniques and use of adaptive equipment (as indicated) to facilitate continued participation in daily activities despite limitations of the shoulder. Frequencies of appointments may also be greater

if workplace limitations are required, and job demands are higher or may require job modifications or adaptive equipment. Post-operative rehabilitation can be considerable, particularly in older patients with other associated injuries such as rotator cuff injuries. In those cases, there may be a requirement for therapy on a prolonged basis to recover as much function as possible.

7. OSTEONECROSIS (AVASCULAR NECROSIS)

7.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing Shoulder Osteonecrosis from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

Category	Recommendation	Evidence
Activity Modification	Aggressive Targeting of Coronary Artery Disease Risk Factors for Treatment of Osteonecrosis	Recommended, Insufficient Evidence (I)
	Avoidance of Dysbaric Exposures or Other Symptom-Provoking Activities / Risk Factors for the Treatment of Osteonecrosis	Recommended, Insufficient Evidence (I)
Allied Health	Hyperbaric Oxygen	Recommended, Insufficient Evidence (I)
Diagnostic Tests	Bone Scanning for Select Use in Acute, Subacute, or Chronic Pain	Recommended, Evidence (C)
	CT for Evaluating Patients with Osteonecrosis (AVN)	Recommended, Insufficient Evidence (I)
	Helical CT for Evaluating Osteonecrosis	Recommended, Insufficient Evidence (I)
	MRI for Diagnosing Osteonecrosis (AVN)	Recommended, Insufficient Evidence (I)
	Positron Emission Tomography (PET) for Diagnosing Osteonecrosis	Not Recommended, Insufficient Evidence (I)
	Ultrasound for Diagnosing Osteonecrosis	No Recommendation, Insufficient Evidence (I)
	X-rays for Acute, Subacute, or Chronic Shoulder Pain and Osteonecrosis	Recommended, Insufficient Evidence (I)

Category	Recommendation	Evidence
	Glucocorticoids (including Injections) for Treatment of Osteonecrosis	Not Recommended, Insufficient Evidence (I)
	Medications for the Treatment of Osteonecrosis	See text
Surgery	Arthroplasty for Osteonecrosis	Recommended, Insufficient Evidence (I)
	Core Decompression Surgery to Treat Osteonecrosis	Recommended, Insufficient Evidence (I)

7.2. OVERVIEW

Osteonecrosis of the humerus is considerably less common than osteonecrosis of the femoral head (726). Osteonecrosis, or avascular necrosis, is a complex pathological process involving increased bone marrow pressure and ischemia with loss of vascular supply to the bone which may progress to bone death initiated by vascular occlusion (726,727,1760,1761,1762). Although it may occur in any bone, it tends to occur in bones that have a more tenuous blood supply, including the heads of the femur, humerus, and other ends of long bones (1763)(1764). If the process advances, the bone collapses (1765).

Most epidemiological literature for osteonecrosis is derived from hip osteonecrosis, with no quality studies of the shoulder. The greatest risk for osteonecrosis is believed to be glucocorticosteroid use (726,1766,1767,1768,1769,1770,1771,1772,1773,1774,1775,728) or endogenous excess glucocorticoids (1775). Other risk factors include diabetes mellitus, arteriovascular disease (727,1769,1776), hyperlipidemia, sickle cell anemia (1772), coagulopathies (1775), Gaucher's disease (727,1769,1771,1772), HIV (1774,1777), post-irradiation (727,1769,1772), alcoholism (727,1769,1772,1774,1775,1776,1778,1779), and smoking . Yet, many cases are idiopathic (727,1780). Genetic factors are also believed to be important (726).

Osteonecrosis appears to have a clinically silent, pre-clinical state (most frequently identified in the asymptomatic hip) (727,1781) that when found first in the shoulder is often present elsewhere, such as in the hips or knees (726,1773,1782). Patients present with either acute or insidious onset of persistent shoulder pain that may be worse with overhead use (727). Pain is often worse at night and may be somewhat worse with activity. Reduced shoulder range of motion may occur and will nearly always be present if there is bony collapse. Pain and range of motion worsen as the degree of impairment progresses (726,727). The disease may be progressive – in the hip there appears to be potential for recovery at any of the early stages (727); thus, the same is thought to be true for osteonecrosis of other bones including that of the humerus (726).

7.3. WORK LIMITATIONS

Divers and other workers in compressed air atmospheres who experience impaired blood supply to the humerus due to nitrogen gas in the blood during excessively rapid decompression may develop osteonecrosis, and thus be considered to have an occupational disorder due to dysbarism (atmospheric compression, decompression). Major trauma is another reported cause (726,727,728,729). Thus, if a humeral fracture is occupational, a subsequent case of osteonecrosis arising out of that humeral fracture may be considered occupational. Whether or not stereotypical forceful use of the joint is a risk is speculative.

Among those developing osteonecrosis, reducing or eliminating activities that significantly provoke symptoms and the disease process (including avoidance of dysbaric exposures) is recommended. There is no quality evidence regarding reducing forceful use, although limitations are sometimes instituted for months; therefore, there is no recommendation for or against reducing forceful use.

7.4. DIAGNOSTIC RECOMMENDATIONS

7.4.1. LABORATORY STUDIES

A general medical evaluation is usually needed as part of the evaluation of a patient with osteonecrosis. This evaluation should be tailored based on the patient's history, although a general profile is usually needed to at minimum include several laboratory studies to evaluate potential causal and/or contributory factors. These studies include complete blood count with differential; general chemistries; hepatic enzymes (including AST, ALT, GGTP); lipid profile; coagulation studies; and hemoglobin A1c. Measurement of glucocorticoids may be needed, although there are usually clues based on other history, physical examination and/or laboratory studies.

In the absence of quality evidence, it is recommended that the diagnosis of shoulder osteonecrosis be managed according to the recommendations for Rotator Cuff Tendinopathy. See the following recommendations:

- Antibodies to Confirm Specific Disorders for Rotator Cuff Tendinopathy *[Recommended, Evidence (C)]*

- Non-specific Inflammatory Markers for Screening for Inflammatory Disorders in Subacute or Chronic Shoulder Pain *[Recommended, Evidence (C)]*
- Cytokine Testing for Chronic Shoulder Pain, including Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*

7.4.2. X-RAYS

Roentgenograms (x-rays) have been used in the diagnosis of osteonecrosis (730) (731) (732).

X-RAYS FOR ACUTE, SUBACUTE, OR CHRONIC SHOULDER PAIN AND OSTEONECROSIS

Recommended

X-rays are recommended for evaluation of acute, subacute, or chronic shoulder pain, including evaluating osteonecrosis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

All patients suspected of having osteonecrosis.

Benefits

Diagnosis of osteonecrosis, fracture, calcific tendinitis, or otherwise latent medical condition(s).

Harms

Medicalization or worsening of otherwise benign shoulder condition; minor radiation exposure.

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient with two to three views. If the patient is thought to have osteonecrosis, but the x-rays are negative, there are other tests to consider such as MRI. For patients with chronic shoulder pain, it may be reasonable to obtain a second set of x-rays later to re-evaluate the patient's condition, particularly if symptoms change.

Indications for Discontinuation

Not applicable.

Rationale

There are no quality studies evaluating the use of x-rays for osteonecrosis. One moderate quality study found bone scan and bone pressure measurements to be more diagnostic than routine radiographs (Zizic et al., 1986). However, X-rays are helpful for initial evaluation of most patients with shoulder pain, including osteonecrosis. Plain radiographic findings are used to stage disease involvement in osteonecrosis or humeral avascular necrosis. Early x-rays are usually normal or have less distinct trabecular patterns (Harreld et al., 2009) (Ficat, 1985). As the disease progresses, x-rays begin to show osteoporotic areas, progressing to sclerotic areas and finally flattening and bony collapse (Harreld et al., 2009) (Ficat, 1985). X-rays also assist both to diagnose and with the differential diagnostic

possibilities such as calcific tendinitis and arthroses. X-rays are non-invasive, low to moderately costly, and have little risk of adverse effects and therefore, are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Radiography, X-Rays, Roentgenograms; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 372 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 373 articles, 206 in Scopus, 4 in CINAHL, 1 in Cochrane Library, 4900 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 3 from other sources. Of the 3 articles considered for inclusion, 2 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

7.4.3. BONE SCANS

Bone scans have been used for the diagnosis of osteonecrosis of the shoulder (109).

BONE SCANNING FOR ACUTE, SUBACUTE, OR CHRONIC PAIN

Sometimes Recommended

Bone scanning, often with SPECT, is recommended for select use in patients with acute, subacute, or chronic pain to assist in the diagnosis of osteonecrosis and other conditions with increased polyostotic bone metabolism, particularly when more than one joint needs to be evaluated.
Strength of evidence Recommended, Evidence (C)
Level of confidence Moderate

Indications

Patients with suspicion of osteonecrosis, or other increased bone metabolism, generally having already had MRI, but with concerns for other problems such as other joint involvement.

Benefits

Some radiation exposure.

Harms

Negligible. Some radiation exposure

Frequency/Dose/Duration

Generally, one evaluation

Rationale

Bone scanning with SPECT is helpful to identify areas of increased bone metabolism (Siddiqui et al., 1993); thus, its primary use is for osteonecrosis cases (typically identified on radiographs) for which there are concerns for other joint involvement. One study suggested bone scanning superior to MRI (Sakai et al., 2001). One moderate quality study found bone scan and bone pressure measurements to be more diagnostic than routine radiographs (Zizic et al., 1986). Bone scanning is minimally invasive, has no adverse effects aside from radiation exposure, but is costly. It is selectively recommended for evaluation of patients with concerns of wider involvement. The threshold for use should generally be low, as wider involvement of osteonecrosis may further emphasize a need for risk factor modification and imaging monitoring of other joints.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Bone Scans, Bone Scintigraphy; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 28 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 28 articles, 16 in Scopus, 1 in CINAHL, 3 in Cochrane Library, 3,020 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 diagnostic study and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

7.4.4. COMPUTED TOMOGRAPHY (CT)

CT FOR EVALUATING PATIENTS WITH OSTEONECROSIS

Sometimes Recommended

CT is selectively recommended for evaluating patients with osteonecrosis, including for patients who need advanced imaging, but have contraindications for MRI or where helical CT is unavailable.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Shoulder pain from osteonecrosis with suspicion of subchondral fracture(s) or increased polyostotic bone metabolism, particularly if there is contraindication for MRI and there is no helical CT available if CT is preferred.

Benefits

Identification of extent and severity of osteonecrosis.

Harms

Negligible. Minor radiation exposure.

Frequency/Dose/Duration

Obtaining serial CT scans to track healing or progression status is reasonable. Generally, one evaluation. A second may be needed if there is a significant clinical change or to evaluate progress/resolution.

Indications for Discontinuation

None specified.

Rationale

There are no quality studies evaluating CT scans. While CT is considered superior to MRI for imaging of most shoulder abnormalities where advanced imaging of calcified structures is required, for osteonecrosis, there is no clear preference of CT over MRI. However, helical CT is generally thought to be preferable to CT for identification of fracturing and thus use of 'plain' CT is limited, including those settings without helical CT.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Computerized Tomography, CT; Osteonecrosis, Osteonecrotic symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 62 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 62 articles, 3 in Scopus, 0 in CINAHL, 11 in Cochrane Library, 2,810 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

7.4.5. HELICAL CT

HELICAL CT FOR EVALUATING OSTEONECROSIS

Sometimes Recommended

Helical CT is recommended for evaluating patients with osteonecrosis who have contraindications for MRI.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Helical CT scans are sometimes used for diagnosing osteonecrosis, especially with concerns about fracturing and collapse. Also indicated for those needing evaluation of osteonecrosis but with contraindications for MRI.

Benefits

Diagnosis of osteonecrosis, subchondral fractures; tracking progression or healing of osteonecrosis.

Harms

Negligible. Minor radiation exposure.

Frequency/Dose/Duration

Generally one evaluation. A second may be needed if there is a significant clinical change or for evaluating progress/resolution.

Rationale

Helical CT is considered superior to MRI for imaging of most shoulder abnormalities where advanced imaging of calcified structures is required. For osteonecrosis, there is no clear preference of CT over MRI. Helical CT is thought to be better than CT at identifying fracturing and is therefore recommended for select use.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Tomography, Spiral Computed, Helical CT scans, Spiral CT scans, Helical Computed Axial Tomography; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 0 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 0 articles, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 200 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If

relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

7.4.6. LOCAL ANESTHETIC INJECTIONS

In the absence of quality evidence, it is recommended that the diagnosis of shoulder osteonecrosis be managed according to the recommendations for rotator cuff tendinopathy.

See Rotator Cuff Tendinopathy Injections.

7.4.7. FUNCTIONAL CAPACITY EVALUATIONS

In the absence of quality evidence, it is recommended that the diagnosis of shoulder osteonecrosis be managed according to the recommendations for Rotator Cuff Tendinopathy. See Functional Capacity Evaluations for Chronic Disabling Shoulder Pain *[Recommended, Insufficient Evidence (I)]*.

7.4.8. MAGNETIC RESONANCE IMAGING (MRI)

Magnetic resonance imaging (MRI) has been used to detect early osteonecrosis of the shoulder because MRI may detect subtle lesions in the bone (733).

MAGNETIC RESONANCE IMAGING (MRI) FOR DIAGNOSING OSTEONECROSIS

Recommended

Magnetic resonance imaging is recommended for diagnosing osteonecrosis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients with subacute or chronic shoulder pain thought to be related to osteonecrosis (AVN), particularly in whom the diagnosis is unclear or in whom additional diagnostic evaluation and staging is needed.

Benefits

Secure a diagnosis, grade severity, assess collapse potential, and stage.

Harms

Negligible

Frequency/Dose/Duration

One MRI is performed for diagnosis and a baseline. A second study at last several weeks later may be used to assess progression and regression, plan surgery and re-stage.

Rationale

Multiple studies show utility of MRI for assessing ON (Blanchard et al., 1999). Helical computerized tomography is considered superior to MRI for imaging bone collapse (Stevens et al., 2003). However, MRI is considered superior for imaging bone marrow edema, which is inversely correlated with prognosis of osteonecrosis. Thus, both tests have their advantages. MRI is not invasive (or minimally so with a contrast exam), has negligible adverse effects, is high cost, has utility for the diagnosis and staging of osteonecrosis and is thus recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnetic Resonance Imaging, MRI Scans; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 102 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 102 articles, 458 in Scopus, 4 in CINAHL, 954 in Cochrane Library, 3180 in Google Scholar, and 1 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 3 articles considered for inclusion, 1 diagnostic study and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

7.4.9. ULTRASOUND

ULTRASOUND FOR DIAGNOSING OSTEONECROSIS

No Recommendation

Ultrasound is neither recommended nor not recommended for use on patients suspected of having osteonecrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Indications

Not specified.

Rationale

There are no quality studies of ultrasound for diagnosing osteonecrosis, and thus there is no recommendation. However, there are other indications for ultrasound.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasound, Ultrasonography;

Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 447 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 447 articles, 141 in Scopus, 0 in CINAHL, 16,947 in Cochrane Library, 2,480 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

7.4.10. POSITRON EMISSION TOMOGRAPHY (PET)

POSITRON EMISSION TOMOGRAPHY (PET) FOR DIAGNOSING OSTEONECROSIS

Not Recommended

PET scanning is not recommended for the evaluation of patients with osteonecrosis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that PET is helpful in improving care of osteonecrosis. Additional studies are needed to determine if PET adds something to the diagnosis, treatment and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, clinical impression and advanced imaging before it can be recommended for evaluating osteonecrosis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Positron Emission Tomography, PET; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 1article in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 1 article, 22 in Scopus, 0in CINAHL, 918 in Cochrane Library, 530 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0from Google Scholar, and 0from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

7.5. TREATMENT RECOMMENDATIONS

7.5.1. ACTIVITY MODIFICATION AND EXERCISE

In the absence of quality evidence for exercise and physical therapy, it is recommended that the treatment of shoulder osteonecrosis be managed according to the following recommendations for Rotator Cuff Tendinopathy and Shoulder Pain:

- Exercise Prescriptions for Shoulder Pain *[Recommended, Evidence (C)]*
- Aerobic Exercises for Treatment of Rotator Cuff Tendinopathies *[Recommended, Insufficient Evidence (I)]*
- Range-of-Motion Exercise for Treatment of Rotator Cuff Tendinopathies *[Recommended, Insufficient Evidence (I)]*
- Strengthening Exercises for Treatment of Rotator Cuff Tendinopathies *[Recommended, Evidence (C)]*
- Physical and/or Occupational Therapy for Treatment of Rotator Cuff Tendinopathies *[Recommended, Insufficient Evidence (I)]*

AVOIDANCE OF DYSBARIC EXPOSURES FOR THE TREATMENT OF OSTEONECROSIS

Recommended

Reduction or elimination of activities that are significant risks for osteonecrosis including the avoidance of dysbaric exposure is recommended.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

All patients with osteonecrosis.

Benefits

Potential to modify the disease course and prevent need for surgery

Harms

Adverse effects of treatments rendered.

Rationale

There are few quality studies evaluating efficacy of risk factor modification for osteonecrosis. As the following are known modifiable risk factors, elimination of decompression exposures, control of diabetes mellitus, elimination of or reductions in glucocorticosteroid use, and elimination of alcohol and tobacco products are all recommended at the time the diagnosis is considered. As there is some evidence statins may reduce risk (Pritchett, 2001), and tobacco is also a risk, the composite data suggest aggressive targeting of all coronary artery disease risk factors is needed and recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Decompression Sickness, Avoidance of Barotrauma, Avoidance of Dysbaric Exposure, Risk Factors; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 22 articles in PubMed, 158 in Scopus, 20 in CINAHL, 0 in Cochrane Library, 1350 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

AVOIDANCE OF SYMPTOM-PROVOKING ACTIVITIES OR OTHER RISK FACTORS FOR THE TREATMENT OF OSTEONECROSIS

Recommended

Reduction or elimination of activities that are significant risks for osteonecrosis, including control of diabetes mellitus, elimination or reductions in glucocorticosteroid use, and elimination of alcohol and tobacco is recommended.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

All patients with osteonecrosis.

Benefits

Potential to modify the disease course and prevent need for surgery

Harms

Adverse effects of treatments rendered.

Rationale

There are few quality studies evaluating efficacy of risk factor modification for osteonecrosis. As the following are known modifiable risk factors, elimination of decompression exposures, control of diabetes mellitus, elimination of or reductions in glucocorticosteroid use, and elimination of alcohol and tobacco products are all recommended at the time the diagnosis is considered. As there is some evidence statins may reduce risk (Pritchett, 2001), and tobacco is also a risk, the composite data suggest aggressive targeting of all coronary artery disease risk factors is needed and recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Decompression Sickness, Avoidance of Barotrauma, Avoidance of Dysbaric Exposure, Risk Factors; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 22 articles in PubMed, 158 in Scopus, 20 in CINAHL, 0 in Cochrane Library, 1350 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

AGGRESSIVE TARGETING OF CORONARY ARTERY DISEASE RISK FACTORS FOR TREATMENT OF OSTEONECROSIS

Recommended

Aggressive targeting of coronary artery disease risk factors is recommended for the treatment of shoulder osteonecrosis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

All patients with osteonecrosis.

Benefits

Potential to modify the disease course and prevent need for surgery

Harms

Adverse effects of treatments rendered.

Rationale

There are no quality trials of aggressive treatments of cardiovascular disease risk factors. Yet, epidemiological evidence supports risks for osteonecrosis associated with diabetes mellitus, alcohol and smoking. Some evidence in limited patients (e.g., renal) also suggest statins are associated with lower risk (Pritchett, 2001) (Ajmal et al., 2009). Anatomical evidence appears to support a disease mechanism based on tenuous blood supply. Thus, there is a rationale for targeting cardiovascular

disease risk factors in patients with osteonecrosis. Although there is no quality evidence of efficacy of cardiovascular disease risk factor modification, it has a strong theoretical construct, is not invasive, has generally low adverse effects, and is only moderately costly depending on the interventions(s). Thus, it is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Aggressive Targeting for Coronary Artery Disease Risk Factors; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 15 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 745 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack.

7.5.2. MEDICATIONS

There is no quality literature specific to shoulder osteonecrosis for nearly all of the following interventions. In the absence of quality evidence, it is recommended that the diagnosis of shoulder osteonecrosis be managed according to the recommendations for Rotator Cuff Tendinopathy and Shoulder Pain:

- NSAIDs for Treatment of Rotator Cuff Tendinopathies and Shoulder Pain *[Strongly Recommended, Evidence (A)]*
- Acetaminophen for Acute, Subacute, Chronic, or Post-operative Shoulder Pain *[Recommended, Insufficient Evidence (I)]*
- Norepinephrine Reuptake Inhibiting Anti-depressants for Subacute or Chronic Shoulder Girdle Pain *[Recommended, Insufficient Evidence (I)]*
- Selective Serotonin Reuptake Inhibitors for Acute, Subacute, or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Anti-convulsants for Acute, Subacute or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Capsicum Creams for Acute, Subacute, Chronic Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*
- Topical NSAIDs, including Diclofenac Epolamine for Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*

- Topical Glyceryl Trinitrate, Lidocaine Patches, Eutectic Mixture of Local Anesthetics (EMLA), and Other Creams/Ointments for Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*

See also the ACOEM Opioids guideline for the treatment of subacute and chronic pain.

BISPHOSPHONATES TO TREAT OSTEONECROSIS

No Recommendation

Bisphosphonates are neither recommended nor not recommended to treat osteonecrosis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no trials on the use of bisphosphonates for shoulder osteonecrosis. Bisphosphonates have been evaluated in multiple moderate quality studies of osteonecrosis in the hip and the results conflict with some showing efficacy with delayed collapse (Lai et al., 2005) (Venesmaa et al., 2001) and some showing lacking efficacy (Chen et al., 2015) (Wang et al., 2008) (Wilkinson et al., 2001). Bisphosphonates are not invasive, have some adverse effects and are moderately costly, but there is substantially conflicting data on efficacy. Thus, there is no recommendation for treatment of the shoulder from inference regarding studies of the hip.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Bisphosphonates, Diphosphonates; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 19 in Scopus, 0 in CINAHL, 4 in Cochrane Library, 1430 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ORAL GLUCOCORTICOIDS FOR TREATMENT OF OSTEONECROSIS

Not Recommended

Oral glucocorticoids are not recommended for treatment of osteonecrosis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There are no quality studies assessing treatment of osteonecrosis with glucocorticosteroids. However, there is strong evidence that glucocorticosteroids are significant risk factors for the condition, thus, by inference, and in the absence of evidence of efficacy, glucocorticosteroids are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Glucocorticoids; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 10 articles in PubMed, 44 in Scopus, 0 in CINAHL, 2 in Cochrane Library, 3,250 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

GLUCOCORTICOID INJECTIONS FOR TREATMENT OF OSTEONECROSIS

Not Recommended

Glucocorticoid injections are not recommended for treatment of osteonecrosis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications for Discontinuation

Not specified.

Rationale

There are no quality studies assessing treatment of osteonecrosis with glucocorticosteroids. However, there is strong evidence that glucocorticosteroids are significant risk factors for the condition, thus, by inference, and in the absence of evidence of efficacy, glucocorticosteroids are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Glucocorticoids; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 10 articles in PubMed, 44 in Scopus, 0 in CINAHL, 2 in Cochrane Library, 3,250 in Google Scholar, and 0 from other sources†. We considered for

inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria. † The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

7.5.3. ALLIED HEALTH INTERVENTIONS

HYPERBARIC OXYGEN FOR OSTEONECROSIS

Recommended

Hyperbaric oxygen is recommended for the treatment of shoulder osteonecrosis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

All patients with osteonecrosis, although especially appears useful for Osteonecrosis Ficat Stage 2. It may be reasonable to attempt HBO in patients with more severe osteonecrosis.

Benefits

Potential to modify the disease course and prevent need for surgery.

Harms

Barotrauma (especially of the ears), oxygen toxicity, claustrophobia/anxiety

Frequency/Dose/Duration

By inference from the hip: 2.5 ATA of hyperbaric oxygen for 82 minutes, comprising a period of 60 minutes when the patient was continuously exposed to 2.5 ATA without interruption, for a total of 30 treatments (Kim et al., 2004).

Indications for Discontinuation

Completion of course, intolerance, clinical resolution, osteonecrosis collapse

Rationale

There are no quality trials for treatment of shoulder ON with hyperbaric oxygen. However, by analogy with hip ON which is believed to have the identical pathophysiological mechanism and intervention (HBO), there is one moderate quality study suggesting durable, reduced need of arthroplasty lasting 7 years among HBO-treated patients (Camporesi et al., 2010), although the sample size is modest. Hyperbaric oxygen has been used to treat osteonecrosis of the jaw (Shimura et al., 2006), but a study following osteonecrosis of the hips of children from chemotherapeutics found no improvements with

hyperbaric oxygen. Despite its high cost, HBO is not invasive, has low adverse events, and has some evidence of efficacy for osteonecrosis of the hip with a durable reduced need of surgery. Thus, it is recommended for treatment of shoulder osteonecrosis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hyperbaric Oxygen Therapy, HBOT, Hyperbaric Oxygenation; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 15 in Scopus, 0 in CINAHL, 2 in Cochrane Library, 437 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

7.5.4. SURGICAL CONSIDERATIONS

There are multiple surgical procedures that have been used for treatment of osteonecrosis, including core decompression similar to that for the hip (726,1781,1783,1784,1785,1786,1787,1788,1789,1790,1791), arthroscopy with or without core decompression (1787,1792,1793), vascularized and devascularized bone grafting (1791,1794,1316,1795,1796,1797), humeral head resurfacing (1750,1758,1798,1799,1800,1801,1802,1803,1804), and arthroplasties (1750,1758,1798,1799,1800,1801,1802). Electrical stimulation is also used on the hip, although there are no quality studies of the procedure (1805).

Core decompression with or without bone grafts is the surgical procedure that has been utilized most frequently to treat osteonecrosis of either the hip or humerus (1806) (1807) (1808) (726,727,1789,1809,1810,1811,1812). The primary purpose of the procedure is to relieve the elevated intramedullary pressure that stagnates microvascular circulation (726,727).

Hemi- and total shoulder arthroplasty have been used for the treatment of osteonecrosis of the shoulder (726) (1798) (1800) (1813) (1814) (1815) (1816) (1817) (1818) (1819) (1820) (1821) (1822) (1823).

CORE DECOMPRESSION SURGERY TO TREAT OSTEONECROSIS

Recommended

Core decompression surgery is recommended to treat osteonecrosis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients with generally moderate to severe osteonecrosis either (i) not responding to risk factor modification and/or (ii) felt to be at risk of collapse and further delay while treating risk factors or treating with hyperbaric oxygen is felt to be too risky.

Benefits

Potential to heal without arthroplasty.

Harms

Superficial and deep infection(s), osteomyelitis, failure to prevent collapse and need for arthroplasty.

Rationale

There are no quality studies of the efficacy of core decompression of the humerus, as the sole quality study included coring in all patients and then compared with/out stem cell injections (Hernigou et al., 2021). Core decompression with or without bone grafts has been widely utilized to treat hip osteonecrosis (Ficat, 1985) (Castro et al., 2000) (Steinberg et al., 2001) (Warner et al., 1987) (Rijnen et al., 2003) (Stulberg et al., 1991), and thus by inference, the humerus. However, the two moderate-quality studies of hips in adults (Koo et al., 1995) (Stulberg et al., 1991) conflict (Castro et al., 2000). The primary purpose of the procedure is to relieve the elevated intramedullary pressure that stagnates the microvascular circulation (Castro et al., 2000). In a case series, results were good in 94% of Stage I and 82% in Stage II. However, a case series cannot prove that earlier treatment results in superior outcomes as results may mislead through spectrum and other biases. While the coring decompression is not without risks and is costly, and although the two quality studies of a coring procedure in the hip conflict, core decompression is selectively recommended based on an apparent trend for the procedure to prevent collapse.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Core Decompression, Core Decompression Surgery; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 12 articles in PubMed, 25 in Scopus, 5 in CINAHL, 1 in Cochrane Library, 1370 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ARTHROPLASTY FOR SHOULDER OSTEONECROSIS

Recommended

Arthroplasty is recommended for treatment of osteonecrosis with collapse or severe disease unresponsive to non-operative treatment.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Patients with collapse of the humeral head are immediate candidates for arthroplasty. Additional candidates include those with severe osteonecrosis who are:

- unresponsive to risk factor modification, and/or
- felt to be at significant risk of immediate collapse.

Benefits

Potential for curative treatment.

Harms

Superficial and deep infection(s), osteomyelitis, risk of requiring explanation. If young individual, increased risk of requiring revision surgery.

Rationale

There are no quality studies of shoulder arthroplasty for ON of the humerus. By analogy, once the head of the femur collapses, the treatment is usually arthroplasty, although early case series reported high revision rates of up to 37% that have more recently declined to approximately 2 to 9% (Salvati et al., 1988) (Chandler et al., 1981) (Saito et al., 1989) (Kantor et al., 1996) (Piston et al., 1994) (Chiu et al., 1997) (Garino et al., 1997) (Stulberg et al., 1997) (Fye et al., 1998) (Kim et al., 2003) (Taylor et al., 2001) (Xenakis et al., 2001) with improvements initially attributed to cementation techniques with subsequent reductions in revisions attributed to cementless techniques (Babis GC, 2004). A few of the quality studies regarding arthroplasty were performed for osteonecrosis, although none solely included those patients (Kim et al., 2003) (Brodner et al., 2003) (Kim et al., 2002). See Hip Osteoarthrosis section on arthroplasty for additional details. The prognosis appears to be reasonably good in more recent studies of these patients and thus, arthroplasty is selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Arthroplasty; Osteonecrosis, Osteonecrotic Symptoms, Avascular Necrosis, Aseptic Necrosis, Ischemic Bone Necrosis, shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 100 articles in PubMed, 264 in Scopus, 25 in CINAHL, 12in Cochrane Library, 5,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 12 from PubMed, 2 from Scopus, 0 from CINAHL,0 from Cochrane Library, 0 from Google

Scholar, and 0 from other sources. Of the 14 articles considered for inclusion, 0 randomized trials and 13 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8. ADHESIVE CAPSULITIS

8.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing adhesive capsulitis from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

8.2. OVERVIEW

Adhesive capsulitis is also known as frozen shoulder, painful stiff shoulder, periarthrosis, or periarthritis (1824,1825,996,1826,1827). However, the disorder continues to be poorly understood and no commonly used term adequately describes the condition as the shoulder is neither frozen, nor are there consistent presence of adhesions and inflammation (1828,1829), nor is it necessarily painful. Reported findings include histological evidence of chronic inflammation, perivascular infiltration, fibrosis of the subsynovial layer, and sometimes there is associated subacromial bursitis (1828,1829,1830). For lack of a better term, "adhesive capsulitis" will be used in this guideline.

The lifetime cumulative incidence of adhesive capsulitis has been estimated at 2 to 5% (1828,734). Most cases begin gradually, although some occur quickly after discrete events such as trauma (794,781,1831). Idiopathic adhesive capsulitis most commonly affects females between age 45 and 65 (80% of cases). There is a 15-20% chance of having bilateral (not concurrent) adhesive capsulitis. Three clinical phases are commonly recognized – inflammatory (pain), stiff (pain and limited motion), and thawing (resolution). The majority of patients resolve with resolution of pain and recovery of close to normal motion (1832). It has been described as a self-limited disease lasting up to 2 to 3 years (1109,1828,794,1831,1832,1833,1834,795,1835,1836,1837,1838,1839,1840,1841,1842,1843), with

10 to 20% of patients having long-term debility (781,1831,1837,1843,782,1844); others have described it as a chronic disorder associated with prolonged disability (1831,1837,1845,1846,1071,788,1847)(1848).

Adhesive capsulitis may be spontaneous and idiopathic, primary (1828,1831,1838,782,1844,788,1849), as well as caused by, or secondary to injuries (1831), prolonged immobilization, rotator cuff tendinopathies (1850,1851,789), surgery, and predisposing medical conditions (1837,1844,1849,1109). Any factor that results in reduced range of motion is thought to be a risk for adhesive capsulitis. There is no quality evidence that work activities are a direct cause (1852), yet workplace injuries may secondarily result in adhesive capsulitis.

Diseases associated with adhesive capsulitis include diabetes mellitus (1824,1835,1853,1854,1855,1856,1857,1858,1859,1860,1861), including a 'dose-response' relationship with severity of diabetes (1862), crystal arthropathies, rheumatoid arthritis, ankylosing spondylitis (1863), other rheumatological diseases (1864), paresis and hemiplegia (1865), hypothyroidism (1824,1853,1858,1866), and thyrotoxicosis (1824). Immunological abnormalities have also been reported (1867). However, the most commonly used classification systems for adhesive capsulitis have generally excluded arthroses and crystal arthropathies (1027). While studies of risk and prognostic factors are notably quite weak, poor clinical prognostic factors include diabetes (1829,1868,1869,1870), prior episodes of shoulder pain, duration of more than 1 month at presentation, passive elevation less than 101ºF, concomitant neck pain, severe daytime pain, and psychosocial stress (1871,1872). The quality of the overall evidence base for treatment of adhesive capsulitis is relatively weak (1080,226,1873,267,1874,1875).

8.3. DIAGNOSTIC CRITERIA

Various criteria have been used. Thus, there are no consensus diagnostic criteria (734,735). Criteria used include gradual onset of global limitation of passive range of motion and normal radiographs other than osteopenia, which might or might not be present.

The diagnosis of adhesive capsulitis is primarily clinical and based on the history and physical examination (735,736). Additional tests are often performed largely to exclude other treatable conditions. X-rays are recommended and may be needed of both shoulders, particularly if there was a bilateral injury or need for comparison with the unaffected shoulder. Other studies may be helpful, including MRI, especially for evaluation of potential rotator cuff tendinopathies or tears.

8.4. WORK LIMITATIONS

Patients with adhesive capsulitis should be encouraged to incrementally perform more work activities to the extent possible, as these activities are generally therapeutic as long as they do not increase shoulder functional loss/ disability. However, some limitations are often needed, especially for more physically demanding work activities. Such limitations are gradually reduced as recovery progresses and may include limitations in heavy lifting and overhead activities. If surgery is performed, there is a similar need for workplace limitations that are gradually reduced. In contrast with numerous other disorders, frequent appointments and therapy to advance exercises, incrementally increase range of motion, work through fear avoidant beliefs, and advance work activities are often needed for patients with adhesive capsulitis.

8.5. DIAGNOSTIC RECOMMENDATIONS

8.5.1. ANTIBODIES

ANTIBODIES TO CONFIRM SPECIFIC DISORDERS

Sometimes Recommended

Antibody levels are selectively recommended to evaluate and diagnose patients with shoulder pain that have reasonable suspicion of rheumatological disorders including inflammatory arthropathies. Antibody levels are strongly recommended as a screen to confirm specific rheumatological disorders when there are indications (e.g., symptoms and/or signs suggestive of rheumatoid arthritis), but are generally not indicated for most patients with other specific soft tissue musculoskeletal disorders, such as rotator cuff tendinopathies due to high false positive rates in that non-specific diagnostic setting. Consultation with a rheumatologist may be helpful when there is a known or suspected disorder.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Shoulder pain and a presumptive diagnosis of an inflammatory rheumatological disorder. May include pain that fails to respond as would be expected, with or without findings in other joints. Findings in other joints increases the probability that testing will be positive. Testing is generally not indicated for most patients with rotator cuff tendinopathies. Testing is also not generally indicated at initial symptoms presentation unless symptoms have been present for at least a few weeks and/or are severe; otherwise, e.g., negative test results are more likely as insufficient time is likely to have passed and may mislead.

Benefits

Secure an accurate diagnosis, which should then focus the treatment plan to more efficacious treatments.

Harms

Potential for false-positive tests; however that is generally minimal unless the pre-test probability is low.

Frequency/Dose/Duration

Generally only ordered one time. However, if the testing was performed early and there is further disease persistence or progression, a second test is reasonable as more time may be required for the antibody tests to become positive.

Rationale

Elevated antibody levels are highly useful for confirming clinical impressions of inflammatory rheumatological diseases. However, routine use of these tests in shoulder pain patients is not recommended, especially as wide-ranging, non-focused test batteries are likely to result in inaccurate

diagnoses due to false positives and low pre-test probabilities. Providers should also be aware that false-negative results occur. Measurement of antibody levels is minimally invasive, unlikely to have substantial adverse effects, and is low to moderately costly depending on the specific test ordered. They are recommended for focused testing of a limited number of diagnostic considerations. However, ordering of a large, diverse array of antibody levels without targeting a few specific disorders diagnostically is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Antibodies; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 9 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 9 articles, 676 in Scopus, 2 in CINAHL, 1 in Cochrane Library, 119 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.5.2. NONSPECIFIC INFLAMMATORY MARKERS

NON-SPECIFIC INFLAMMATORY MARKERS FOR SCREENING FOR INFLAMMATORY DISORDERS IN SUBACUTE OR CHRONIC SHOULDER PAIN

Sometimes Recommended

Serum measures of erythrocyte sedimentation rate, C-reactive protein, creatine kinase muscle, aldolase, hyaluronic acid, and other inflammatory markers are selectively recommended for screening either inflammatory disorders with reasonable suspicion of inflammatory disorder in patients with subacute or chronic shoulder pain or osteoarthrosis. They are generally not indicated for patients with non-specific disorders, such as rotator cuff tendinopathies.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Shoulder pain and a presumption of an inflammatory process. Pain that fails to respond as would be expected, with or without findings in other joints. Findings in other joints increases the probability that testing will be positive. Testing is generally not indicated for most patients with rotator cuff tendinopathies. Testing is also not generally indicated at initial symptoms presentation unless symptoms have been present for at least a few weeks and/or are severe; otherwise, e.g., negative test results are more likely as insufficient time is likely to have passed and may mislead.

Benefits

Identify whether an inflammatory process is likely, which may help focus on the need for further testing to secure an accurate diagnosis.

Harms

Potential for false-positive tests; however, that is generally minimal unless the pre-test probability is low.

Frequency/Dose/Duration

Generally only ordered one time. However, if the testing was performed early, and there is further disease persistence or progression, a second test is reasonable as the inflammatory mediators may have needed additional time to become positive.

Rationale

Erythrocyte sedimentation rate (ESR) is the most commonly used systemic marker for non-specific inflammation. It is elevated in numerous inflammatory conditions including rheumatological disorders as well as infectious diseases. C-reactive protein (CRP) is a marker of systemic inflammation that has been associated with an increased risk of coronary artery disease. It is also a non-specific marker for other inflammation. Both ESR and CRP are also markers of infection. Numerous inflammatory markers have been found to be elevated in patients with musculoskeletal disorders but because it is not known whether these factors precede or are a consequence of the disease processes, their utility in patient management is unclear. Other non-specific markers of inflammation include elevated ferritin and an elevated protein-albumin gap, neither of which have known clinical roles. Serological studies for non-specific inflammatory markers are minimally invasive, have low risk of adverse effects, and are low cost. They are recommended as a reasonable screen for systemic inflammatory conditions especially if the patient also has other pain without clear definition of a diagnosis or those with fibromyalgia or myofascial pain syndrome, although specificity is not high. However, ordering of a large, diverse array of anti-inflammatory markers without targeting a few specific disorders diagnostically is not recommended.

A large study found elevated biomarkers (C-reactive protein, creatine kinase muscle, aldolase) are associated with osteoarthrosis compared with normal controls (Ganguly, 2019). Another study found elevated serum hyaluronic acid levels among both those with either rheumatoid arthritis or osteoarthrosis, although the HA levels were higher among those with rheumatoid arthritis (Goldberg RL, 1991) and TNF alpha, IL-1B, IL-10 and IL-17 (Hussein et al., 2008). However, clear distinctions between these measures among those with osteoarthrosis and inflammatory arthropathies is not apparent in the available literature. Thus, the utility of these tests may be as potential screening for arthropathies irrespective of inflammatory arthroses.

A high-quality, 7-year study of 880 elderly subjects evaluated impacts of IL-6 and CRP on both cross-sectional associations with morbidity and long-term mortality (Taaffe DR, 2000). CRP and IL-6 were higher among smokers at baseline and those with higher body mass indexes (BMIs). IL-6 and CRP were also higher among those with hypertension, myocardial infarction, stroke, glycosylated hemoglobin levels, HDL, and number of chronic conditions. Both IL-6 and CRP were inversely related to quartiles of moderate and strenuous physical activity. CRP and/or IL-6 were associated with incidence of hypertension, myocardial infarction, diabetes, and incident cases of chronic conditions. Physical performance measures of changes in grip strength, signature time, chair-rise and 6-m fast walk all were not significant for IL-6 or CRP.

Serological studies for non-specific inflammatory markers are minimally invasive, have low risk of adverse effects, and are low cost. They are recommended as a screen for systemic inflammatory and osteoarthrosis conditions especially if the patient also has other pain without clear definition of a diagnosis, although specificity is not high and these measures tend to be elevated in both osteoarthrosis and inflammatory disorders, with higher levels among those with inflammatory disorders. However, ordering of a large, diverse array of anti-inflammatory markers without targeting a few specific disorders diagnostically is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: blood sedimentation, c reactive protein, procalcitonin, nonspecific inflammatory markers; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 6 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 6 articles, 756 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 11,000 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 6 from Google Scholar, and 0 from other sources. Of the 8 articles considered for inclusion, 5 diagnostic studies and 0 systematic reviews met the inclusion criteria.†

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cytokines; osteoarthritis, degenerative joint disease, shoulder, glenohumeral joint, acromioclavicular joint; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 12 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 12 articles, 1030 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 12,000 in Google Scholar, and 0from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.†

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: C-Reactive Protein, Erythrocyte Sedimentation Rate, Non-Specific Inflammatory Markers; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 35 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 37 articles, 61 in Scopus, 10 in CINAHL, 3 in Cochrane Library, 171 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.5.3. CYTOKINES

CYTOKINE TESTING FOR CHRONIC SHOULDER PAIN, INCLUDING ROTATOR CUFF TENDINOPATHIES

Not Recommended

Routine testing with or the use of batteries of cytokine tests is not recommended to diagnose chronic shoulder pain, including rotator cuff tendinopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Cytokines purportedly determine whether a patient is experiencing pain or has suffered a toxicological insult. However, there are no quality studies that address this premise. Available studies suggest that these markers may be elevated in chronic pain conditions, but these studies did not have adequate control groups and did not control for potential confounders. The range of disorders in which cytokines may be elevated also needs definition, as the current range of conditions appears large (Taaffe DR, 2000, Martelletti, 1999, Perini, 2005, Covelli, 1991, Gratt, 2005, Alexander, 1998, Chen, 2004, Gur, 2002, Madson, 1994), suggesting they are not specifically isolated to patients with chronic pain, and thus the specificity of these tests seems likely to be quite low.

A high-quality, 7-year study of 880 elderly subjects evaluated impacts of IL-6 and CRP on both cross-sectional associations with morbidity and long-term mortality (Taaffe DR, 2000). CRP and IL-6 were higher among smokers at baseline and those with higher body mass indexes (BMIs). IL-6 and CRP were also higher among those with hypertension, myocardial infarction, stroke, glycosylated hemoglobin levels, HDL, and number of chronic conditions. Both IL-6 and CRP were inversely related to quartiles of moderate and strenuous physical activity. CRP and/or IL-6 were associated with incidence of hypertension, myocardial infarction, diabetes, and incident cases of chronic conditions. Physical performance measures of changes in grip strength, signature time, chair-rise and 6-m fast walk all were not significant for IL-6 or CRP. Cytokines need to be rigorously studied to ascertain if there is a place for them in the evaluation and/or management of chronic pain conditions, including stratification for occupationally-relevant diseases.

Documentation that the discovery of elevated cytokine levels results in changes in evaluation and/or clinical management is also necessary. Alternatively, this testing may be useful if the absence of elevated cytokine levels would warrant concluding that a patient does not have a remediable physical cause of shoulder pain. While cytokine testing is minimally invasive, and has a low risk of adverse effects, these tests are high cost, with no evidence that they alter the clinical management of patients with chronic shoulder pain. Their place in the evaluation of patients with chronic shoulder pain is yet to be determined and cytokine testing is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cytokines, Interleukins, Chemokines and lymphokines; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries,

shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 56 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 76 articles, 545 in Scopus, 12 in CINAHL, 1 in Cochrane Library, 218 in Google Scholar, and 0 from other sources†. We considered for inclusion 5 from PubMed, 2 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 8 articles considered for inclusion, 0 diagnostic studies and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.5.4. X-RAYS

X-RAYS FOR ADHESIVE CAPSULITIS

Recommended

X-rays are recommended for evaluation of adhesive capsulitis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

All patients suspected with adhesive capsulitis.

Benefits

Diagnosis of calcific tendinitis, arthritides, fracture or otherwise latent medical condition(s).

Harms

Negligible; minor radiation exposure.

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient with two to three views. For patients with chronic adhesive capsulitis and/or shoulder pain, it may be reasonable to obtain another set of x-rays later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

There are no quality studies that help define the utility of x-rays, as the only comparative study had sample sizes that were too small to define the utility of x-rays (Simmonds, 1949). However, x-rays are clinically helpful to evaluate adhesive capsulitis, particularly to assist in differential diagnostic possibilities such as arthritides, tendinosis, and calcific tendinitis, which result in different treatment approaches. X-rays are non-invasive, are of low to moderate cost, may alter the treatment course, and have little risk of adverse effects. X-rays are, therefore recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Roentgenograms, X-Rays, Radiography, Roentgenograph; adhesive capsulitis, frozen shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 1046 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 1046 articles, 95 in Scopus, 12 in CINAHL, 1 in Cochrane Library, 6860 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 1 diagnostic study and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.5.5. BONE SCANNING

Bone scanning is not indicated for simple adhesive capsulitis, but there are other indications. See Rotator Cuff Tendinopathy.

8.5.6. COMPUTED TOMOGRAPHY

Computerized tomography remains an important imaging procedure, particularly for bony anatomy, whereas MRI is superior for soft tissue abnormalities. However, most patients have issues with soft tissue rather than bony abnormalities in the shoulder, thus on a population-basis, far fewer CT scans are ordered. CT may nevertheless be useful for shoulder joint abnormalities where advanced imaging of the bones is required (i.e., complex proximal humerus fracture, scapular fracture). CT also may be useful to evaluate the anatomy in patients with contraindications for MRI (most typically an implanted metallic-ferrous device). CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – such as, glenoid deficiency and humeral Hill-Sachs lesion – as MRI is not as good for bone imaging. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear. Computed tomography (CT) has been used to diagnose adhesive capsulitis (723) (737) (738) (739).

CT FOR ADHESIVE CAPSULITIS

Recommended

Computerized tomography is selectively recommended for the evaluation of adhesive capsulitis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Imaging for adhesive capsulitis which particularly includes concerns about osseous abnormalities or other calcified structures. For most cases of adhesive capsulitis, x-rays and potentially MRI suffice. CT may be indicated when MRI is contraindicated.

Benefits

Diagnosis and understanding of the degree of osseous structures, complex fractures, calcific tendinitis.

Harms

Radiation exposure.

Frequency/Dose/Duration

Obtaining a CT once is generally sufficient. For patients with ongoing adhesive capsulitis and chronic shoulder pain, it may be reasonable to obtain a second CT later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

One controlled study suggested adhesive capsulitis is associated with a decreased axillary recess width with lateral thickening and medial joint capsule thickening at the axillary recess (Cerny et al., 2017). X-rays and MRI are sufficient for most adhesive capsulitis patient evaluations. CT is superior where imaging calcified structures is required, such as for calcific tendinitis. CT arthrogram can be selectively used in place of MRI to evaluate for rotator cuff tear. MRI is considered superior to computerized tomography for imaging most shoulder abnormalities where advanced imaging of soft tissues is usually the primary concern. A contrast CT study is minimally invasive, has few, if any, adverse effects but is costly. It is recommended for select use.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Computer Tomography (CT); adhesive capsulitis, frozen shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 326 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 326 articles, 221 in Scopus, 10 in CINAHL, 70 in Cochrane Library, 4170 in Google Scholar, and 0 from other sources†. We considered for inclusion 3 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 1 diagnostic study and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.5.7. DIAGNOSTIC ANESTHETIC INJECTIONS

Diagnostic injections particularly of the subacromial space, glenohumeral joint and acromioclavicular joint are sometimes performed. However, particularly for adhesive capsulitis, they are nearly always performed in combination with a glucocorticosteroid injection (see Injection Therapies). Injection with a therapeutic agent is nearly always preferable due to less overall invasiveness with 1 injection rather than 2, as well as the potential to assess the patient both immediately post-injection for diagnostic purposes as well as longer term for therapeutic purposes.

8.5.8. ELECTROMYOGRAPHY

See the Cervical and Thoracic Spine Disorders and Hand, Wrist, and Forearm Disorders guidelines for discussions regarding use of electrodiagnostic studies for evaluation of cervical spine and distal upper extremity-related disorders that may present as shoulder pain. Electrodiagnostic studies have also been used to confirm diagnostic impressions of other peripheral nerve entrapments, brachial plexopathies, and neurologic component of thoracic outlet syndrome.

8.5.9. FUNCTIONAL CAPACITY EVALUATIONS

FUNCTIONAL CAPACITY EVALUATIONS FOR CHRONIC DISABLING SHOULDER PAIN

Recommended

Functional capacity evaluations (FCEs) are recommended as an option for evaluation of disabling chronic shoulder pain where the information may be helpful to attempt to objectify worker capability, function, motivation, and effort vis-à-vis either a specific job or general job requirements. There are circumstances where a patient is not progressing as anticipated at 6 to 8 weeks and an FCE may help evaluate functional status and patient performance in order to match performance to specific job demands, particularly in instances where those demands are medium to heavy. If a provider is comfortable describing work ability without an FCE, there is no requirement to do this testing. Recordings or observation for signs of mismatch between effort and self-reported abilities may be particularly helpful.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Patients with moderate to severe chronic shoulder pain that has ongoing functional impairments and need to attempt to identify and quantify limitations. There are circumstances where a patient is not progressing as anticipated at 6 to 8 weeks and an FCE can evaluate functional status and patient performance in order to match performance to specific job demands, particularly in instances where those demands are medium to heavy. More typically, FCEs are useful after a healing plateau is established whether surgery was performed or not. If a provider is comfortable describing work ability without an FCE, there is no requirement to do this testing. Recordings or observation for signs of mismatch between effort and self-reported abilities may be particularly helpful.

Benefits

Identification and enumeration of limitations. Assess functional abilities and may facilitate greater confidence in return to work.

Harms

Inappropriately low estimates of abilities, self-limitation of efforts, excessive disability, inappropriately precluding the performance of tasks and activities the person could safely perform. Medicalization, worsening of shoulder pain with testing; may have misleading results that understate capabilities.

Frequency/Dose/Duration

Generally, only one test is needed. A repeat FCE may be needed if there are substantial changes in the person's condition or status, or if there is a need to assess projected performance against a different set of job criteria.

Rationale

There are no quality studies of FCEs to evaluate ability to perform work and/or work limitations. Yet, FCEs are one of the few means to attempt to objectify limitations and are frequently used in workers' compensation systems, particularly as the correlation between clinical pain ratings and functional abilities appears weak (Brouwer et al., 2005, Gross et al., 2003, Reneman et al., 2002, Reneman et al., 2007, Schiphorst Preuper et al., 2008, Smeets et al., 2007, Eriksen et al., 2006). However, obtaining objective data regarding shoulder problems is somewhat more challenging than for distal upper extremity-related impairments due to the degree of reliance on the patient's subjective willingness to exert or sustain major activities that are critical for job performance. Because their reliability and validity have not been proven, FCEs should be utilized to evaluate work ability about what a patient was willing to do on a given day. They should be carefully performed and interpreted, but FCEs should not be used to override the judgment about the work ability of a patient with a shoulder problem.

Many commercial FCE models are available. There is research regarding inter-and intra-rater reliability for some of the models (complete discussion is beyond the scope of this guideline). The validity of FCEs, particularly predictive validity, is more difficult to determine, since factors other than physical performance may affect return to work (Pransky et al., 2004, Gouttebarge et al., 2004). An FCE may be done for one or more reasons, including identifying an individual's ability to perform specific job tasks associated with a job (job-specific FCE) and physical activities associated with any job (general FCE), or to assist in the objectification of the degree(s) of impairment(s). The type of FCE needed, and any other issues the FCE evaluator needs to address, should be specified when requesting an FCE.

The term "capacity" used in FCE may be misleading, since an FCE generally measures an individual's voluntary performance rather than his or her capacity. Physical performance is affected by psychosocial as well as physical factors. The extent of an individual's performance should be evaluated as part of the FCE process through analysis of his or her level of physical effort (based on physiological and biomechanical changes during activity) and consistency of performance. Perhaps more importantly, the objective findings identified in the musculoskeletal evaluation should correlate with any identified functional deficits. The individual's performance level, especially as it relates to stated levels of performance, should be discussed in the FCE report. A properly performed and well-reported FCE will highlight such discrepancies. This is particularly important in shoulder evaluations where there may be greater degrees of impairments at stake and where there are somewhat fewer metrics available than for the distal upper extremity.

FCE test components may vary depending on the model used, but most contain the following:

- Patient interview including: informed consent, injury/illness and medical history, current symptoms, activities and stated limitations, pain ratings/disability questionnaires
- Musculoskeletal examination (e.g., including analogues of Waddell's non-organic signs for the shoulder such as non-anatomic pain)
- Observations throughout the session (e.g., demonstrated sitting tolerance, pain modifying behaviors)
- Material handling tests (lifting, carrying, pushing, pulling)
- Movement tests (walking, crouching, kneeling, reaching, etc.)
- Positional tolerance tests
- Dexterity/hand function
- Static strength (varies among models)
- Aerobic fitness (usually submaximal test-also variable among models)
- Job-specific activities as relevant
- Reliability of client reporting (e.g., non-organic signs, pain questionnaires, placebo tests, etc.)
- Physical effort testing (e.g., Jamar Dynamometer maximum voluntary effort, bell curve analysis, rapid exchange grip, competitive test performance, heart rate, observation of clinical inconsistencies, etc.)

FCE test length may vary between FCE models, although most 1-day FCEs are completed in 3 to 4 hours. Two-day tests, where the patient is seen on 2 consecutive days, may be recommended when there are problems with fatigue (e.g., chronic fatigue syndrome), delayed onset of symptoms, unusually complex job demands to simulate, and questions about symptom validity. Test length for 2-day tests is generally 3 to 4 hours on the first day, and 2 to 3 hours on the second day.

Interpretation of FCE results is complicated in that it is a measure of voluntary performance. Before beginning testing, the patient is counseled to avoid doing anything to knowingly reinjure him or herself. Thus, "fear avoidance" may cause testing to seriously underestimate actual ability and result in a report that the patient had "self-limited performance due to pain," suggesting a low pain tolerance, when in reality the patient was doing what he or she was instructed.

By analogy, the best studies on the ability of FCEs to predict safe re-entry to the workplace following rehabilitation of work-related back pain/injury suggest that FCEs are not able to predict safe return to work (concurrent validity) (Gross et al., 2005, Gross et al., 2004, Gross et al., 2004). In a prospective cohort study of 1,438 consecutive work-related back patients, all underwent an FCE prior to return to work. In the control group, the FCE was used to write return-to-work guidelines, while in the study group it was ignored and the worker was returned usually to full duty. Ignoring the FCE improved outcome (Hall et al., 1994).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Functional Capacity Evaluations; rotator cuff tendinopathy, rotator cuff tear, shoulder pain, rotator cuff injuries, shoulder impingement syndrome, calcific tendinitis, subacromial bursitis, supraspinatus tendinitis; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, efficiency. We found and reviewed 6 articles in PubMed using Most Recent tab, and we did a

secondary search in PubMed using Best Match tab to find and review 34 articles, 42 in Scopus, 8,289 in CINAHL, 11 in Cochrane Library, 334 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.5.10. MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for many shoulder joint problems since it is helpful for imaging soft tissues, particularly the rotator cuff (591) (592) (593) (594) (595) (57) (596) (597) (598) (599) (600) (601). MRI has been commonly used to assist in the diagnosis and differential diagnosis of adhesive capsulitis of the shoulder (740) (741) (742) (743) (744) (745) (746) (747) (748) (749) (750) (751) (752) (753) (754) (755) (756) (757) (758) (759) (760) (761) (762).

MRI FOR ADHESIVE CAPSULITIS

Sometimes Recommended

MRI is selectively recommended for patients with adhesive capsulitis who are also suspected of having rotator cuff tears or other soft tissue abnormalities potentially contributing to the adhesive capsulitis or relevant for the differential diagnosis.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence High

Indications

Patients with adhesive capsulitis who are also thought to have a rotator cuff tear or other soft tissue abnormalities potentially contributing to the adhesive capsulitis. Generally, 4-6 weeks of non-operative treatment is indicated prior to MRA; however, if there is significant rotator cuff weakness, immediate imaging may be indicated. MRI may be indicated as well for concerns about thoracic injury. Exceptions include elderly patients, those who would not undergo surgical repair, or those who have substantial signs of pre-existing large/massive rotator cuff tear.

Benefits

Secure a secondary diagnosis.

Harms

False positives and false negatives for rotator cuff tears.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

There are many quality studies of MRI for evaluation of adhesive capsulitis. There are multiple abnormalities that have been strongly associated with adhesive capsulitis, including:

- axillary-recess capsule signal enhancement (T1-weighted);
- capsular thickness;
- hyperintense signals (T2-weighted fat-suppressed imaging),
- distention of the bursa in the superior subscapularis recess;
- enhancement of the coracohumeral ligament signal;
- coracohumeral ligament shortening;
- inferior glenohumeral ligament hyperintensity; and
- coracohumeral ligament at the rotator cuff interval with complete obliteration of the fat triangle below the coracoid process (Ahn K-S, 2015) (Carbone et al., 2014) (Chi et al., 2017) (Jung et al., 2019) (Li et al., 2011) (Park et al., 2019) (Teixeira et al., 2012) (Zhao et al., 2012) (Pessis et al., 2020).

MRI is also helpful for evaluation of rotator cuff tendinopathies (See Rotator Cuff Tendinopathy). However, there are no studies demonstrating that MRI alters the clinical course of adhesive capsulitis in most patients. There are concerns that MRI is inferior to MR arthrography for evaluating the labrum (Schmerl et al., 2005), thus MRA is selectively recommended for that purpose. MRI is not invasive, has potential adverse effects from issues of claustrophobia or complications of medication, but is costly. MRI is recommended for select evaluation of adhesive capsulitis cases, particularly involving concerns regarding secondary soft tissue pathology and otherwise treatable, causal disorders.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnetic Resonance Imaging (MRI); adhesive capsulitis, frozen shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 848 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 848 articles, 800 in Scopus, 28 in CINAHL, 5 in Cochrane Library, 14100 in Google Scholar, and 1 from other sources†. We considered for inclusion 14 from PubMed, 1 from Scopus, 8 from CINAHL, 1 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 25 articles considered for inclusion, 12 diagnostic studies and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.5.11. MAGNETIC RESONANCE ARTHROGRAM

Magnetic resonance (MR) arthrography combines MRI with an arthrogram to overcome MRI limitations and is usually performed in preference to CT arthrography unless bony structure definition is needed as well (173) (174). MR arthrography is particularly thought to be effective for imaging labral pathology (175) (176) (177) (178) (179) (180) (43) (181). Magnetic Resonance Arthrography has been used to diagnose adhesive capsulitis (750) (763) (764) (765) (766) (767) (768) (769) (770) (771) (772) (773) (774) (775) (776) (777).

MR ARTHROGRAM FOR DIAGNOSING ADHESIVE CAPSULITIS

Recommended

MR arthrography is selectively recommended for diagnosing labral tears in patients with adhesive capsulitis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Use of MRA in patients with adhesive capsulitis is quite limited. Patients with adhesive capsulitis who also have symptoms of, or strong clinical suspicion of clinically meaningful labral tears. Patients should generally have failed non-operative treatment of the labral tear or soft tissue including NSAID and waiting 4 to 6 weeks without trending towards resolution.

Benefits

Secure a surgical diagnosis.

Harms

False positives and false negatives for labral tears. Arthrography improves the accuracy especially regarding complete rotator cuff tears and significant labral tears. Small risk of infection and complications from the injection.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

MR arthrograms have been evaluated in several quality studies among patients with adhesive capsulitis, and while MRI findings were highly diagnostic for adhesive capsulitis (link to MRI section), MRA was of no or limited additive value in multiple studies (Pessis et al., 2020) (Manton GL, 2001) (Jung et al., 2006) (Mengiardi et al., 2004). Another study found decreased glenohumeral distance, capsule thickening and decreased axillary recess capacity (Lee et al., 2017) and another found decreased joint capacity (Ogul H, 2019) as associated with adhesive capsulitis. MR arthrography is invasive, has adverse effects including a low, but definite risk of infection and is painful. It is also costly, although MRA has been felt to provide better cost effectiveness than MRI or CT arthrography for select diagnoses (Oh et al., 1999). For patients with adhesive capsulitis, it is likely limited to patients thought to have a clinically meaningful labral tear or patients with good strength in order to assess the labrum

and rotator cuff with traumatic injury simultaneously and thus, is recommended for highly selective use. For the vast majority of adhesive capsulitis patients, MRA is not believed to be of additive value to MRI.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnetic Resonance Arthrogram, adhesive capsulitis, frozen shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 81 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 81 articles, 33 in Scopus, 1 in CINAHL, 3 in Cochrane Library, 1950 in Google Scholar, and 0 from other sources†. We considered for inclusion 15 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 17 articles considered for inclusion, 8 diagnostic studies and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.5.12. ULTRASOUND

Diagnostic ultrasound has been used to evaluate adhesive capsulitis of the shoulder (754) (758) (778).

ULTRASOUND FOR EVALUATING ADHESIVE CAPSULITIS

Recommended

Ultrasound is selectively recommended for adhesive capsulitis patients also suspected of having rotator cuff tears, tendinoses, or impingement.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Ultrasound technicians should have sufficient skill to obviate the need for scanning (Boykin et al., 2010) (Hanchard et al., 2013), otherwise the test introduces unnecessary redundancy. Patients with adhesive capsulitis who also have symptoms and signs of a clinically significant acute rotator cuff tear or subacute or chronic shoulder pain suspected of having a symptomatic rotator cuff tear (Ardic et al., 2006) (Iannotti et al., 2005) (Wall et al., 2012) (Naredo et al., 1999). Most clinical presentations should wait approximately 2 weeks prior to imaging as some patients with acute pain and limited range of motion resolve clinically; obvious major tears are an exception to waiting two weeks. Those with subacute or chronic pain should generally have failed additional non-operative treatment including NSAID, exercise and injection(s) (Ottenheijm et al., 2010). An MR arthrogram is recommended for suspected labral injury (Ardic et al., 2006).

Benefits

Secure a diagnosis.

Harms

False positives and false negatives.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

Two comparative studies used MRI and suggested US has some utility in the diagnosis of adhesive capsulitis (Park et al., 2017) (Sernik et al., 2019). Ultrasound also has utility to identify some of the confounding or contributing conditions, such as rotator cuff tendinopathy (See RC Tendinopathy) but does not well visualize other conditions such as SLAP tears. Ultrasound is not invasive, is of low to moderate cost, and has little risk of adverse effects; therefore, although there are concerns that MRI may be superior for imaging most shoulder soft tissues, ultrasound is recommended particularly for evaluation of rotator cuff tears as a complicating disorder for adhesive capsulitis. The main disadvantage is the high dependency on the physician's skills (Boykin et al., 2010) (Hanchard et al., 2013).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasonography, Ultrasound; adhesive capsulitis, frozen shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 1752 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 1769 articles, 109 in Scopus, 15 in CINAHL, 8102 in Cochrane Library, 13,100 in Google Scholar, and 2from other sources†. We considered for inclusion 1 from PubMed, 2 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 2 from other sources. Of the 7 articles considered for inclusion, 3 diagnostic studies and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.5.13. SINGLE PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

Single-proton emission computed tomography (SPECT) is a 3-dimensional imaging technique. Single-photon emission computed tomography (SPECT) has been used for shoulder-pain related complications (195).

SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT) FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendation regarding SPECT scanning for the evaluation of patients with Adhesive Capsulitis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

A large study of F-Fluoro-Deoxy-Glucose PET/computed tomography (F-FDG PET/CT) found only 56% sensitivity (Sridharan et al., 2017), thus the diagnostic utility of PET/CT, if any, may be quite limited. Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating adhesive capsulitis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Single Photon Emission Computed Tomography, SPECT; adhesive capsulitis, frozen shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 7 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 7 articles, 3 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 819 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.5.14. POSITRON EMISSION TOMOGRAPHY (PET)

Positron emission tomography has been used to diagnose adhesive capsulitis (779) (780).

POSITRON EMISSION TOMOGRAPHY (PET) FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendation regarding PET for the evaluation of patients with adhesive capsulitis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

A large study of F-Fluoro-Deoxy-Glucose PET/computed tomography (F-FDG PET/CT) found only 56% sensitivity (Sridharan et al., 2017), thus the diagnostic utility of PET/CT, if any, may be quite limited. Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating adhesive capsulitis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: positron emission tomography, adhesive capsulitis, frozen shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 32 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 32 articles, 48 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 1530 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 2 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.6. TREATMENT RECOMMENDATIONS

8.6.1. INITIAL CARE

Initial care of adhesive capsulitis involves identification and treatment of potential confounding conditions (e.g., diabetes mellitus, other medical disorders, rotator cuff tendinopathies, etc.). Non-operative treatment has been traditionally recommended (781) (782) (134) (783) (784) (785) (786) (787). Educating the patient regarding the generally good long-term prognosis and need to persist in performing progressive exercises is recommended. For patients with significant pain, over-the-counter analgesics and self-applications of heat and ice are recommended (788) (789) (790) (791). Slings, braces and immobilizers tend to increase debility while slowing recovery and are thus not recommended.

OTC analgesics are used for the treatment of adhesive capsulitis (792) (793).

OTC ANALGESICS FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Over-the-counter analgesics are recommended for treatment of adhesive capsulitis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Adhesive capsulitis and other shoulder pain

Benefits

Self-management of the pain.

Harms

Negligible for OTC analgesics unless acetaminophen doses exceed 3.5g, or the patient has liver disease or another condition necessitating lower doses.

Frequency/Dose/Duration

Analgesics should be used per manufacturer's recommendations

Indications for Discontinuation

Resolution of pain, lack of efficacy, intolerance, complication.

Rationale

There are no quality trials evaluating analgesics for managing adhesive capsulitis. However, analgesics and OTC NSAIDs are likely helpful and there is some quality evidence for the use of prescription NSAIDs for other shoulder nociceptive pain (see NSAIDs for rotator cuff tendinopathy), thus they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: nonprescription analgesics, Acetaminophen, Analgesics, Nonprescription drugs, anti-inflammatory agents, anti-inflammatory drugs, non-steroidal, over the counter analgesics; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 53 articles in PubMed, 14 in Scopus, 13 in CINAHL, 870 in Cochrane Library, 1,120 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms.

Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SELF-APPLICATION OF HEAT TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Self-application of heat is recommended for treatment of adhesive capsulitis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Adhesive capsulitis and associated injury(ies).

Benefits

Self-management of the pain.

Harms

Negligible.

Frequency/Dose/Duration

Ice and heat are typically used 3-5 times a day.

Indications for Discontinuation

Resolution of pain, lack of efficacy, intolerance, complication.

Rationale

There are no quality trials evaluating analgesics, ice or heat for managing adhesive capsulitis. Self-applications of heat and ice may be helpful for self-management of symptoms, are not invasive, have low adverse effects, not costly, and are believed to be helpful for treating symptoms; thus, they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Heat, heat therapy, self-application of heat; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 17 articles in PubMed, 91 in Scopus, 9 in CINAHL, in 0 Cochrane Library, 13,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SELF-APPLICATION OF ICE FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Self-application of ice is recommended for treatment of adhesive capsulitis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Adhesive capsulitis and associated injury(ies).

Benefits

Self-management of the pain.

Harms

Negligible.

Frequency/Dose/Duration

Ice and heat are typically used 3-5 times a day.

Indications for Discontinuation

Resolution of pain, lack of efficacy, intolerance, complication.

Rationale

There are no quality trials evaluating analgesics, ice or heat for managing adhesive capsulitis. Self-applications of heat and ice may be helpful for self-management of symptoms, are not invasive, have low adverse effects, not costly, and are believed to be helpful for treating symptoms; thus, they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Self-Application of Ice, Application of Ice, Ice Application; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 2 articles in PubMed, 92 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 224 in

Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.6.2. MEDICATIONS

Most medications have not been assessed in adhesive capsulitis patients. Thus, other than where there is evidence noted, most guidance is based on inference from treatment of rotator cuff tendinopathy and/or patients with general non-specific shoulder pain.

Over-the-counter medications may help manage pain associated with adhesive capsulitis. Medications utilized include acetaminophen and NSAIDs (794) (795) (796) (797), with NSAIDs showing greater efficacy in treatment of other MSDs, but acetaminophen having a generally greater safety profile. Opioids are not indicated other than for post-operative pain management. Other medications that have been used to treat adhesive capsulitis include glucosamine, chondroitin, methylsulfonylmethane, and topical agents such as capsaicin. Oral glucocorticosteroids have also been utilized for treatment of adhesive capsulitis (797) (798) (799) (800).

In the absence of quality evidence, it is recommended that the diagnosis of adhesive capsulitis be managed according to the recommendations for Rotator Cuff Tendinopathy and Shoulder Pain:

- NSAIDs for Treatment of Rotator Cuff Tendinopathies and Shoulder Pain *[Strongly Recommended, Evidence (A)]*
- Acetaminophen for Acute, Subacute, Chronic, or Post-operative Shoulder Pain *[Recommended, Insufficient Evidence (I)]*
- Norepinephrine Reuptake Inhibiting Anti-depressants for Subacute or Chronic Shoulder Girdle Pain *[Recommended, Insufficient Evidence (I)]*
- Selective Serotonin Reuptake Inhibitors for Acute, Subacute, or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Anti-convulsants for Acute, Subacute or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Capsicum Creams for Acute, Subacute, Chronic Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*
- Topical NSAIDs, including Diclofenac Epolamine for Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*
- Topical Glyceryl Trinitrate, Lidocaine Patches, Eutectic Mixture of Local Anesthetics (EMLA), and Other Creams/Ointments for Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*

See also the ACOEM Opioids guideline for the treatment of subacute and chronic pain.

ORAL GLUCOCORTICOSTEROIDS FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Oral glucocorticosteroids are selectively recommended for treatment of adhesive capsulitis.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Adhesive capsulitis patients who decline glenohumeral glucocorticosteroid injection, as results with injection appear superior (Widiastuti-Samekto et al., 2004).

Benefits

Improvements in adhesive capsulitis including range of motion.

Harms

Rare infection, short-term worsened diabetic control.

Frequency/Dose/Duration

The higher quality trial used triamcinolone 4mg PO TID for 1 week, then 4mg BID for 1 week, then 4mg QD for 1 week (Widiastuti-Samekto et al., 2004). Another moderate-quality RCT utilized cortisone acetate 50mg QID for 3 days, then 25mg QID until Day 14 (Blockey et al., 1954). There are no head-to-head comparisons in quality studies of different oral medications to ascertain either the optimum medication(s) or dose(s).

Indications for Discontinuation

Generally only 1 course administered.

Rationale

One placebo-controlled trial suggested modest efficacy of oral steroids (Blockey et al., 1954). However, another moderate-quality trial that compared injection with oral steroids found substantially faster improvements with injections (Widiastuti-Samekto et al., 2004). Oral glucocorticosteroids are not invasive, have adverse effects, and are low cost. As the speed of recovery appears substantially faster via the injected route (Widiastuti-Samekto et al., 2004), oral glucocorticosteroids are recommended only for patients who decline injection.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Oral Glucocorticosteroids, betamethasone, budesonide, cortisone, dexamethasone, hydrocortisone, methylprednisolone; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 143 articles in PubMed, 67 in Scopus, 25 in CINAHL, 638 in Cochrane Library, 12 in Google Scholar, and 0 from other sources†. We considered for inclusion 4 from PubMed, 0 from Scopus, 0 from CINAHL, 0

from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 5 articles considered for inclusion, 2 randomized trial and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.6.3. ACTIVITY MODIFICATION AND EXERCISE

Therapy, including education and exercise, is thought to be particularly important, especially for more severely affected patients with adhesive capsulitis. The duration of rehabilitation is not specifically defined, yet there is strong belief in the importance of this exercise/ rehabilitation for treatment of adhesive capsulitis patients. Continuous passive motion (CPM) also has been utilized for treatment of adhesive capsulitis as well as a post-surgical treatment.

EDUCATION FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Prescriptions for services that include education are recommended for treatment of adhesive capsulitis.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence High

Indications

All adhesive capsulitis patients (Loew et al., 2005) (Lee et al., 1974) (Lee et al., 1973).

Benefits

Not specified.

Frequency/Dose/Duration

Education is needed, particularly to provide longer-term perspective regarding the need for persistent advances in ROM and participation in activities, especially meaningful employment, as a method for improving motion.

Frequency of appointments varies based on severity, compliance, need for encouragement, comorbid conditions, and prior patient experiences.

Rationale

While there is no quality evidence on the value of education, it is believed to be needed to especially provide longer-term perspective regarding the need for persistent advances in ROM and participation in activities, especially meaningful employment, as a method for improving motion.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Education, patient education; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 81 articles in PubMed, 644 in Scopus, 18 in CINAHL, 36 in Cochrane Library, 12,300 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EXERCISE FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Prescriptions for exercise are recommended for treatment of adhesive capsulitis.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence High

Indications

All adhesive capsulitis patients (Loew et al., 2005) (Lee et al., 1974) (Lee et al., 1973). Most patients need formal therapy to help with graded increases in range of motion and then institution of strengthening exercises.

Benefits

Improved range of motion and reduction in pain

Harms

Negligible other than some pain with exercises.

Frequency/Dose/Duration

Progressive passive ROM exercises (Nicholson, 1985) (van der Windt et al., 1998), including a home exercise program (HEP) are thought to be essential to successful treatment of adhesive capsulitis.

Frequency of appointments varies based on severity, compliance, need for encouragement, comorbid conditions, and prior patient experiences. ROM exercises are the primary exercises for this disorder, although they are typically followed by isometric strengthening program, then isotonic strengthening and endurance exercises. Options include weekly appointments to oversee and advance a home

exercise program for several weeks until sufficient recovered for lower grade injuries and self-motivated patients. Patients with a more severe case or need of supervision may require appointments 2 to 3 per week to initiate program exercises, tapering to 1 per week in approximately 4 weeks before being discharged to a home exercise program in approximately 2 months for more severe injuries. Total numbers of appointments among those severely affected can often be ~15-20. Additional appointments should be based on objective, incremental functional gains.

Results of the exercise prescription should be regularly monitored and failure to progressively improve is an indication to either revisit the differential diagnosis and/or seek a second opinion/consultation, particularly by the time approximately 6-12 therapy appointments is reached.

Indications for Discontinuation

Recovery, plateau in recovery, noncompliance, or intolerance.

Rationale

There are many quality trials evaluating exercise, education, and/or therapy for adhesive capsulitis, although few compare exercise or physiotherapy with no treatment. Overall details vary in the available trials. One moderate-quality trial comparing exercise plus placebo injection compared with placebo injection suggested modestly better effects with exercise (Ryans et al., 2005), although the same trial suggested glucocorticoid injections are superior. There are three moderate-quality trials suggesting injections are superior to physiotherapy (Carette et al., 2003) (van der Windt et al., 1998) (Ryans et al., 2005) (see graph in injections below) and one lower quality study suggesting equal efficacy (Dacre et al., 1989). There is evidence that arthrographic distension with steroid plus exercise is superior to exercise alone (Khan et al., 2005). One moderate-quality trial suggested exercise in combination with either electroacupuncture or interferential therapy is superior to no treatment (Cheing et al., 2008). Exercise is not invasive, has low adverse effects, and is of moderate cost for aggregate appointments. There is quality evidence of efficacy for treatment of adhesive capsulitis, thus exercise and therapy are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: post-operative exercise, post-operative rehabilitation, rehabilitation program, rehabilitation, post-operative period, exercise therapy; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 11 articles in PubMed, 17 in Scopus, 3 in CINAHL, 21 in Cochrane Library, 18,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: General exercise, exercise, exercise therapy; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized,

randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 217 articles in PubMed, 2,074 in Scopus, 97 in CINAHL, 3 in Cochrane Library, 15,700 in Google Scholar, and 1 from other sources†. We considered for inclusion 5 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 8 articles considered for inclusion, 7 randomized trials and 0 systematic reviews met the inclusion criteria.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Strengthening Exercises, Resistance Training, Weight-Lifting; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 15 articles in PubMed, 34 in Scopus, 4 in CINAHL, 36 in Cochrane Library, 20300 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 3 from Scopus, 1 from CINAHL, 1 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 9 articles considered for inclusion, 5 randomized trials and 4 systematic reviews met the inclusion criteria.

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Range of motion exercise, articular range of motion; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 410 articles in PubMed, 1,378 in Scopus, 13 in CINAHL, 3 in Cochrane Library, 260 in Google Scholar, and 0 from other sources†. We considered for inclusion 4 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 7 articles considered for inclusion, 5 randomized trials and 1 systematic review met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SLINGS FOR TREATMENT OF ADHESIVE CAPSULITIS

Not Recommended

Slings and braces are not recommended for treatment of adhesive capsulitis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

There are no quality studies of the use of slings for adhesive capsulitis. Importantly, instead of inactivity, adhesive capsulitis is treated with increased range of motion. Slings, braces and immobilizers are believed to be risks for, and potentially aggravate, adhesive capsulitis by reducing range of motion. A sling is also generally not recommended after injections, hydrodilatation, or post-

operatively as immediate ROM is desired. Thus, slings, braces and immobilizers are not recommended for patients with adhesive capsulitis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Slings, Braces, Shoulder Supports; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 283 articles in PubMed, 132 in Scopus, 2 in CINAHL, 103 in Cochrane Library, 20500 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.6.4. ALLIED HEALTH INTERVENTIONS

Therapy, including education and exercise, is thought to be particularly important, especially for more severely affected patients with adhesive capsulitis. The duration of rehabilitation is not specifically defined, yet there is strong belief in the importance of this exercise/ rehabilitation for treatment of adhesive capsulitis patients. Continuous passive motion (CPM) also has been utilized for treatment of adhesive capsulitis as well as a post-surgical treatment.

COGNITIVE BEHAVIORAL THERAPY FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Cognitive behavioral therapy is recommended for treatment of adhesive capsulitis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

All adhesive capsulitis patients, especially those moderately or severely affected. Also particularly indicated for those who fail to improve and/or have significant range of motion limitations and fear avoidant beliefs.

Benefits

Improved clinical course trajectory, including range of motion and reduction in pain

Harms

Negligible

Frequency/Dose/Duration

CBT psychotherapy provided either independently or as a component therapy integrated into a program that includes physical therapy. CBT should normally be limited to 6 sessions or less initially. Additional appointments may be needed, especially for those with a more severe condition or slower clinical progress. Provision of additional appointments should be contingent on compliance with the requirements from the initial set of appointments. When therapy is provided as a component of an interdisciplinary or functional restoration program, the number of sessions is based on the needs of the program to provide relevant treatment objectives.

Indications for Discontinuation

Recovery, plateau in recovery, or noncompliance.

Rationale

There are no quality trials evaluating cognitive behavioral therapy for the treatment of adhesive capsulitis. However, it has been shown to be effective in many other musculoskeletal conditions and thus is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Cognitive Behavioral Therapy, Cognitive Therapy; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 6 in Scopus, 1 in CINAHL, 0 in Cochrane Library, 10700 in Google Scholar, and 0 from other sources†. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PHYSICAL THERAPY FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Prescriptions for instruction and physical therapy services are recommended for treatment of adhesive capsulitis.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence High

Indications

All adhesive capsulitis patients (Loew et al., 2005) (Lee et al., 1974) (Lee et al., 1973). Most patients need formal therapy to help with graded increases in range of motion and then institution of strengthening exercises.

Benefits

Improved range of motion and reduction in pain

Harms

Negligible other than some pain with exercises.

Frequency/Dose/Duration

Progressive passive ROM exercises (Nicholson, 1985) (van der Windt et al., 1998), including a home exercise program (HEP) are thought to be essential to successful treatment of adhesive capsulitis.

Frequency of appointments varies based on severity, compliance, need for encouragement, comorbid conditions, and prior patient experiences. ROM exercises are the primary exercises for this disorder, although they are typically followed by isometric strengthening program, then isotonic strengthening and endurance exercises. Options include weekly appointments to oversee and advance a home exercise program for several weeks until sufficient recovered for lower grade injuries and self-motivated patients. Patients with a more severe case or need of supervision may require appointments 2 to 3 per week to initiate program exercises, tapering to 1 per week in approximately 4 weeks before being discharged to a home exercise program in approximately 2 months for more severe injuries. total numbers of appointments among those severely affected can often be ~15-20. Additional appointments should be based on objective, incremental functional gains.

Results of the exercise prescription should be regularly monitored and failure to progressively improve is an indication to either revisit the differential diagnosis and/or seek a second opinion/consultation, particularly by the time approximately 6-12 therapy appointments is reached.

Indications for Discontinuation

Recovery, plateau in recovery, noncompliance, or intolerance.

Rationale

There are many quality trials evaluating exercise, education, and/or therapy for adhesive capsulitis, although few compare exercise or physiotherapy with no treatment. Overall details vary in the available trials. One moderate-quality trial comparing exercise plus placebo injection compared with placebo injection suggested modestly better effects with exercise (Ryans et al., 2005), although the same trial suggested glucocorticoid injections are superior. There are three moderate-quality trials suggesting injections are superior to physiotherapy (Carette et al., 2003) (van der Windt et al., 1998) (Ryans et al., 2005) (see graph in injections below) and one lower quality study suggesting equal efficacy (Dacre et al., 1989). There is evidence that arthrographic distension with steroid plus exercise is superior to exercise alone (Khan et al., 2005). One moderate-quality trial suggested exercise in combination with either electroacupuncture or interferential therapy is superior to no treatment (Cheing et al., 2008). Exercise is not invasive, has low adverse effects, and is of moderate cost for

aggregate appointments. There is quality evidence of efficacy for treatment of adhesive capsulitis, thus exercise and therapy are recommended. While there is no quality evidence on the value of education, it is believed to be needed to especially provide longer-term perspective regarding the need for persistent advances in ROM and participation in activities, especially meaningful employment, as a method for improving motion.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Physical Therapy, Physiotherapy, Physical Therapy Modalities; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 324 articles in PubMed, 1000 in Scopus, 98 in CINAHL, 105 in Cochrane Library, 17900 in Google Scholar, and 0 from other sources†. We considered for inclusion 8 from PubMed, 7 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 3 from Google Scholar, and 0 from other sources. Of the 18 articles considered for inclusion, 9 randomized trials and 4 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MIRROR THERAPY FOR THE TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Mirror therapy is recommended for treatment of adhesive capsulitis as an adjunct to therapy including an exercise program.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Adhesive capsulitis, especially among those with range of motion limitations, lack of progress with therapy, and fear avoidant beliefs.

Benefits

Improved range of motion, function and pain reduction.

Harms

Negligible

Frequency/Dose/Duration

10 sessions were used in a successful trial (Başkaya et al., 2018). Subsequent sets of 6-10 appointments should be based on incremental gains yet failing to achieve either a plateau and/or normal range of motion.

Indications for Discontinuation

Normal range of motion, achieving a plateau, failure to achieve incremental gains, non-compliance.

Rationale

A moderate quality trial found additive benefits of mirror therapy to (Başkaya et al., 2018). Mirror therapy is non-invasive, has negligible adverse effects, is low cost as an adjunct to therapy, and has evidence of efficacy and is thus recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Mirror Therapy; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 6 in Scopus, 2 in CINAHL, 7 in Cochrane Library, 3,270 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

CONTINUOUS PASSIVE MOTION FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Continuous passive motion (CPM) is selectively recommended in conjunction with a home exercise program for treatment, but only for those with moderate to severe adhesive capsulitis.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Moderate to severely affected adhesive capsulitis patients (599)

Benefits

Improved range of motion and reduction in pain

Harms

Negligible other than some pain with exercises.

Frequency/Dose/Duration

CPM for 1 hour per day, 5 days per week for 20 appointments, combined with a daily home exercise program of progressive stretching and pendulum exercises (599); additional supervised physical or occupational therapy appointments may be needed for more severely affected patients (see above).

Indications for Discontinuation

Recovery, plateau in recovery, noncompliance, or intolerance.

Rationale

There is limited evidence from one moderate-quality trial that CPM plus a home exercise program of stretching and pendulum exercises may be superior to conventional physiotherapy plus the same home exercise program (599). This trial suggested CPM is superior to conventional physiotherapy for pain relief at both 4 and 12 weeks follow-up. CPM is not invasive, has low adverse effects, is moderately costly in aggregate appointments, has some quality evidence of efficacy, and thus is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Continuous Passive Motion, CPM, Motion Therapy, Continuous Passive; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 30 articles in PubMed, 2 in Scopus, 37 in CINAHL, 1 in Cochrane Library, 15900 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MOBILIZATION FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Mobilization is moderately recommended for the treatment of adhesive capsulitis, in combination with a multi-modal approach of exercise and patient education.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Adhesive capsulitis, especially moderate to severely affected patients with pain and loss of active motion who do not respond sufficiently to NSAIDs, and steroid injection(s) (Loew et al., 2005) (Quraishi et al., 2007).

Benefits

Improved range of motion

Harms

Post-procedure pain.

Frequency/Dose/Duration

Generally 1 to 2 appointments a week with intervening home exercises for 3 to 4 weeks. High-grade mobilization techniques are particularly recommended (Vermeulen et al., 2006). Additional 2 sets of up to 8 appointments based on ongoing objective improvements in the condition and ROM. A maximum of 24 appointments has been suggested ((Vermeulen et al., 2006). Some patients will not readily tolerate mobilization of the shoulder without anesthesia; in such cases additional mobilization treatments are not recommended. Encourage patients to use the affected shoulder whenever possible (Vermeulen et al., 2006), and continue home exercises and education.

Indications for Discontinuation

Recovery, plateau in recovery, noncompliance with exercise program, intolerance.

Rationale

There are no quality trials evaluating mobilization or manual therapy to a sham. However, one high-quality trial suggested high-grade mobilizations are modestly superior to low-grade mobilizations (Vermeulen et al., 2006), thus supporting an evidence-based graded recommendation for use of mobilizations for treatment of adhesive capsulitis. One trial comparing mobilizations with injection and cold therapy appears underpowered to detect differences (Bulgen et al., 1984). The other available quality trials include manipulation under anesthesia (MUA); many others included mobilization or manual therapy as part of physiotherapy, thus precluding assessment of its independent benefits. For those who can tolerate it, mobilization or manual therapy without anesthesia may be beneficial and without some of the considerable adverse effects documented with MUA (Loew et al., 2005). Mobilization and manual therapy of the shoulder are not invasive, have low adverse effects, are moderately costly for aggregate appointments, and have evidence suggesting efficacy. Thus, mobilization and manual therapy of the shoulder for adhesive capsulitis is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Mobilization, Manual Therapy; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 180 articles in PubMed, 1,733 in Scopus, 93 in CINAHL, 105 in Cochrane Library, 7,090 in Google

Scholar, and 2 from other sources†. We considered for inclusion 16 from PubMed, 1 from Scopus, 12 from CINAHL, 0 from Cochrane Library, 5 from Google Scholar, and 2 from other sources. Of the 36 articles considered for inclusion, 28 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANUAL THERAPY FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Manual therapy ismoderately recommended for the treatment of adhesive capsulitis, in combination with a multi-modal approach of exercise and patient education.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Adhesive capsulitis, especially moderate to severely affected patients with pain and loss of active motion who do not respond sufficiently to NSAIDs, and steroid injection(s) (Loew et al., 2005) (Quraishi et al., 2007).

Benefits

Improved range of motion

Harms

Post-procedure pain.

Frequency/Dose/Duration

Mobilization and/or manual therapy generally 1 to 2 appointments a week with intervening home exercises for 3 to 4 weeks. High-grade mobilization techniques are particularly recommended (Vermeulen et al., 2006). Additional 2 sets of up to 8 appointments based on ongoing objective improvements in the condition and ROM. A maximum of 24 appointments has been suggested (Vermeulen et al., 2006). Some patients will not readily tolerate mobilization of the shoulder without anesthesia; in such cases additional mobilization treatments are not recommended. Encourage patients to use the affected shoulder whenever possible (Vermeulen et al., 2006), and continue home exercises and education.

Indications for Discontinuation

Recovery, plateau in recovery, noncompliance with exercise program, intolerance.

Rationale

There are no quality trials evaluating mobilization or manual therapy to a sham. However, one high-quality trial suggested high-grade mobilizations are modestly superior to low-grade mobilizations (Vermeulen et al., 2006), thus supporting an evidence-based graded recommendation for use of mobilizations for treatment of adhesive capsulitis. One trial comparing mobilizations with injection and cold therapy appears underpowered to detect differences (Bulgen et al., 1984). The other available quality trials include manipulation under anesthesia (MUA); many others included mobilization or manual therapy as part of physiotherapy, thus precluding assessment of its independent benefits. For those who can tolerate it, mobilization or manual therapy without anesthesia may be beneficial and without some of the considerable adverse effects documented with MUA (Loew et al., 2005). Mobilization and manual therapy of the shoulder are not invasive, have low adverse effects, are moderately costly for aggregate appointments, and have evidence suggesting efficacy. Thus, mobilization and manual therapy of the shoulder for adhesive capsulitis is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Mobilization, Manual Therapy; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 180 articles in PubMed, 1,733 in Scopus, 93 in CINAHL, 105 in Cochrane Library, 7,090 in Google Scholar, and 2 from other sources†. We considered for inclusion 16 from PubMed, 1 from Scopus, 12 from CINAHL, 0 from Cochrane Library, 5 from Google Scholar, and 2 from other sources. Of the 36 articles considered for inclusion, 28 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANIPULATION UNDER ANESTHESIA FOR TREATMENT OF ADHESIVE CAPSULITIS IN SELECT PATIENTS

Recommended

Manipulation under anesthesia is recommended for treatment of adhesive capsulitis in select patients.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Adhesive capsulitis, especially moderate to severely affected patients with pain and loss of active motion who do not respond sufficiently to NSAIDs, steroid injection(s), and hydrodilatation (Loew et al., 2005) (Quraishi et al., 2007).

Benefits

Improved range of motion

Harms

Complications of anesthesia, post-procedure pain, hemarthrosis, localized or disseminated synovitis, capsule rupture, SLAP tears, proximal humerus fracture, rotator cuff tear, and articular damage (Loew et al., 2005).

Frequency/Dose/Duration

Generally, only 1 treatment performed; adequate, safe monitoring of anesthesia is required. A second procedure would be potentially recommended based on incremental gain from the first but an incomplete and insufficiently satisfactory result. Treatment should be combined with post-procedure exercises.

Indications for Discontinuation

Not specified.

Rationale

There are a few quality trials evaluating MUA for adhesive capsulitis (Quraishi et al., 2007) (Kivimaki et al., 2007) (Jacobs et al., 2009). The highest moderate-quality studies suggested modest benefits when comparing MUA with physiotherapy to physiotherapy alone and suggested modest improvements in ROM (Kivimaki et al., 2007). A moderate-quality trial suggested that injections are of comparable efficacy to MUA (Jacobs et al., 2009). Another moderate-quality trial suggested that hydrodilatation is superior to MUA (Quraishi et al., 2007). One moderate-quality trial assessed adjunctive use of intra-articular glucocorticosteroid and found no evidence of benefit of the steroid (Kivimaki et al., 2001). MUA is minimally invasive, except for the anesthesia, but has documented adverse effects (Loew et al., 2005), and is high cost. MUA is recommended for selective use in patients who fail other treatments with documented efficacy, but who have lower risks for adverse effects.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Manipulation under Anesthesia, MUA; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 72 articles in PubMed, 484 in Scopus, 27 in CINAHL, 48 in Cochrane Library, 5390 in Google Scholar, and 4 from other sources†. We considered for inclusion 17 from PubMed, 7 from Scopus, 2 from CINAHL, 0 from Cochrane Library, 16 from Google Scholar, and 4 from other sources. Of the 46 articles considered for inclusion, 11 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search,

and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ACUPUNCTURE FOR TREATMENT OF ADHESIVE CAPSULITIS IN SELECT PATIENTS

Recommended

Acupuncture is recommended for selective treatment of adhesive capsulitis patients.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Adhesive capsulitis, especially moderate to severely affected patients with pain and loss of motion. Generally, used among those who do not respond sufficiently to NSAIDs, steroid injection(s), and hydrodilatation (Loew et al., 2005) (Quraishi et al., 2007), although some patients may prefer acupuncture to injection and hydrodilatation which also may be reasonable. Should be accompanied by an active exercise program (Lathia et al., 2009) (Sun et al., 2001).

Benefits

Modest improvements in pain and range of motion

Harms

Negligible in experienced hands. Has been associated with deep structure punctures and lacerations particularly in inexperienced hands.

Frequency/Dose/Duration

Regimens vary widely in quality trials. An initial trial of 4 appointments appears reasonable combined with a conditioning program of aerobic and strengthening exercises. An additional 4 appointments should be tied to improvements in objective measures after first 4 treatments, for a total of 8 appointments (de Hoyos et al., 2004). Subsequent batches of 4 appointments should be based on ongoing incremental increases in objective measures such as range of motion.

Indications for Discontinuation

Recovery, plateau in recovery, noncompliance with exercise program, intolerance.

Rationale

There are a few moderate-quality trials of acupuncture that appear to have included adhesive capsulitis patients (Lathia et al., 2009) (Sun et al., 2001) (Cheing et al., 2008) (Berry et al., 1980). One moderate-quality trial found acupuncture superior to sham acupuncture (Lathia et al., 2009). A second moderate-quality trial suggested exercise plus acupuncture was superior to acupuncture alone (Sun et al., 2001). However, one lower quality trial suggested there was no difference between electroacupuncture plus exercise and interferential plus exercise (Cheing et al., 2008) and the lowest quality study appears to have found no benefit of acupuncture compared with placebo (Berry et al., 1980). Acupuncture is minimally invasive, has minor adverse effects provided needles are not inserted

deeply, is moderately costly in aggregate, and the highest quality studies suggest benefits. Therefore, acupuncture is selectively recommended as an adjunct to an active exercise program in patients failing other treatments with documented efficacy.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Acupuncture, Acupuncture Therapy, Acupuncture Analgesia, Acupuncture Points; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 67 articles in PubMed, 583 in Scopus, 23 in CINAHL, 1 in Cochrane Library, 3,890 in Google Scholar, and 5 from other sources†. We considered for inclusion 3 from PubMed, 4 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 6 from Google Scholar, and 5 from other sources. Of the 18 articles considered for inclusion, 14 randomized trials and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MAGNETS FOR TREATMENT OF ADHESIVE CAPSULITIS

Not Recommended

Magnetic stimulation and magnets have been used to treat adhesive capsulitis (Kanai et al., 2004).
Strength of evidence Not Recommended, Evidence (C)
Level of confidence High

Benefits

Not specified.

Rationale

One moderate-quality trial suggests magnets are not effective (Leclaire et al., 1991). Magnets are not recommended as there is no quality evidence of efficacy. They also have been shown to be ineffective for treatment of other musculoskeletal disorders.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnets, Magnetic Stimulation, Magnetic Field Therapy; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 4 articles in PubMed, 417 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 1,590 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from

Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 2 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TAPING OR KINESIOTAPING FOR TREATMENT OF ADHESIVE CAPSULITIS

Not Recommended

Taping or kinesiotaping is not recommended for the treatment of adhesive capsulitis.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies assessing efficacy of taping or kinesiotaping. There are three RCTs, all with sparse methods and other methodological problems. One included multiple co-interventions, precluding an assessment of efficacy (Sinaj et al., 2015). One suggests kinesiotaping is superior to ultrasound (Jindal, 2018). Another suggested comparability with shockwave (Choi JH, 2017). Taping is generally not indicated for conditions where increasing range of motion is the prime objective, and thus it is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Taping, Athletic Taping, Kinesiotaping, Taping or Strapping, Athletic Tape; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 5 articles in PubMed, 18 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 3030 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 8 from Google Scholar, and 0 from other sources. Of the 8 articles considered for inclusion, 8 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.6.5. ELECTRICAL THERAPIES

SHORTWAVE DIATHERMY FOR ADHESIVE CAPSULITIS

Recommended

Shortwave diathermy is recommended for the treatment of adhesive capsulitis (Leung et al., 2008).
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Adhesive capsulitis of at least 8 weeks duration (Leung et al., 2008); consideration but not a requirement of inadequate response to injection.

Benefits

Modest improvements in adhesive capsulitis

Harms

Negligible

Frequency/Dose/Duration

Three times a week up to 4 weeks (Leung et al., 2008) which should be combined with exercises (Leung et al., 2008).

Indications for Discontinuation

Resolution, sufficient improvement, intolerance, noncompliance with exercises.

Rationale

A trial suggested significant improvements in frozen shoulder with diathermy (Leung et al., 2008). Diathemy is not invasive, has negligible adverse effects, is moderate cost in aggregate and is thus recommended for treatment of adhesive capsulitis.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Shortwave Diathermy; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 47 in Scopus, 3 in CINAHL, 6 in Cochrane Library, 152 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 3 from Google Scholar, and 1 from other sources. Of the 4 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms.

Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INTERFERENTIAL THERAPY FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendation for interferential therapy.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies and thus there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Interferential Therapy, Interferential Current Electrotherapy, Electric Stimulation Therapy, adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 38 articles in PubMed, 247 in Scopus, 2 in CINAHL, 25 in Cochrane Library, 520 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

HIGH-VOLTAGE GALVANIC STIMULATION FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendation for high-voltage galvanic stimulation.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies and thus there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: High-Voltage Pulsed Galvanic Stimulation, High Voltage Galvanic Stimulation, High-Voltage Galvanism, High-Voltage Galvanic; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 121 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

H-WAVE® DEVICE STIMULATION FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendation for H-Wave® Device stimulation for treatment of adhesive capsulitis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies and thus there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: H-wave Device Stimulation; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 2 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

IONTOPHORESIS FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendation for use of iontophoresis for treatment of adhesive capsulitis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Indications

There are no quality studies and thus there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Iontophoresis; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 2 articles in PubMed, 77 in Scopus, 2 in CINAHL, 0 in Cochrane Library, 553 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 2 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MICROCURRENT STIMULATION FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendation for microcurrent stimulation for adhesive capsulitis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies and thus there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: **Microcurrent, microcurrent electrical stimulation**; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 21 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 67 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from

Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PERCUTANEOUS ELECTRICAL NERVE STIMULATION (PENS) FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendation for PENS for treatment of adhesive capsulitis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies and thus there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Percutaneous Electrical Nerve Stimulation (PENS) OR Percutaneous Neuromodulation Therapy (PNT); adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 27 articles in PubMed, 0 in Scopus, 4 in CINAHL, 2 in Cochrane Library, 109 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SYMPATHETIC ELECTROTHERAPY FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendation for sympathetic electrotherapy for adhesive capsulitis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies and thus there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Sympathetic Electrotherapy, Sympathetic Electrical Stimulation Therapy, Sympathetic Therapy; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 8 in Scopus, 0 in CINAHL, 2 in Cochrane Library, 4580 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendation for TENS for adhesive capsulitis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies assessing efficacy of TENS and thus there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Transcutaneous Electrical Nerve Stimulation; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 27 articles in PubMed, 320 in Scopus, 4 in CINAHL, 45 in Cochrane Library, 4,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 2 from other sources. Of the 2 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EXTRACORPOREAL SHOCKWAVE THERAPY (ECT) FOR ADHESIVE CAPSULITIS

Recommended

Extracorporeal shockwave therapy is recommended for treatment of adhesive capsulitis.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Moderate to severe adhesive capsulitis, generally after institution of an exercise program with insufficient results to improve range of motion and function, typically after at least 2-3 weeks.

Benefits

Improved pain and range of motion

Harms

Increased pain

Frequency/Dose/Duration

4 applications 1 week apart (Hussein et al., 2016).

Indications for Discontinuation

Intolerance, non-compliance.

Rationale

Two sham-controlled trials suggested efficacy of EWST (Hussein et al., 2016) (Vahdatpour et al., 2014), and one showed durable efficacy to 24 weeks (Hussein et al., 2016). Another trial suggested superiority of EWST to oral steroid (Chen et al., 2014). EWST is not invasive and has low adverse effects. Though EWST is high cost, it has evidence of efficacy and is thus recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Extracorporeal Shockwave Therapy, ESWT, Ultrasonic Therapy, Shockwave Therapy; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 5 articles in PubMed, 58 in Scopus, 21 in CINAHL, 3 in Cochrane Library, 789 in Google Scholar, and 1 from other sources†. We considered for inclusion 2 from PubMed, 6 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 7 from Google Scholar, and 1 from other sources. Of the 17 articles considered for inclusion, 6 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ELECTRICAL MUSCLE STIMULATION (EMS) FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendations for electrical muscle stimulation for treatment of adhesive capsulitis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: electrical muscle stimulation, neuromuscular electrical stimulation, EMS, NMES; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 43 in Scopus, 6 in CINAHL, 9 in Cochrane Library, 13900 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PULSED ELECTROMAGNETIC FIELD THERAPY FOR ADHESIVE CAPSULITIS

No Recommendation

There is no recommendation for pulsed electromagnetic field therapy.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies and thus there is no recommendation for pulsed electromagnetic field therapy.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Pulsed Electromagnetic Field, Pulsed Electromagnetic Field Therapy, PEMF, REMF Therapy, Low Field Magnetic Stimulation, LFMS; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 9 articles in PubMed, 58 in Scopus, 3 in CINAHL, 10 in Cochrane Library, 1,130 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

HIGH-INTENSITY LASER THERAPY FOR ADHESIVE CAPSULITIS

Recommended

High-intensity laser therapy (HILT) is selectively recommended for treatment of adhesive capsulitis.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Adhesive capsulitis and should generally have failed at least 3 weeks of exercises and at least one glucocorticosteroid injection.

Benefits

Improved pain, resolution of the disorder

Harms

Negligible

Frequency/Dose/Duration

Three sessions for 3 weeks. Should be co-administered with exercises (Kim, 2015) (Atan, 2021).

Indications for Discontinuation

Intolerance, non-compliance

Rationale

There are few quality studies of HILT. One trial suggests superiority of HILT to sham (Kim, 2015). A second trial suggested HILT plus exercises were superior to same HILT plus exercise and also superior to exercises alone (Atan, 2021). HILT is not invasive and has negligible adverse effects, with some studies suggesting efficacy. Thus, it is selectively recommended for those who fail exercises and prior glucocorticoid injection(s).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Other physical methods, physical methods; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 594 articles in PubMed, 2,380 in Scopus, 46 in CINAHL, 0 in Cochrane Library, 1,310 in Google Scholar, and 4 from other sources†. We considered for inclusion 3 from PubMed, 0 from Scopus, 4 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 4 from other sources. Of the 11 articles considered for inclusion, 4 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.6.6. INJECTION THERAPIES

Glucocorticoid injections are commonly performed for treatment of adhesive capsulitis. Suprascapular nerve blocks, platelet-rich plasma, and viscosupplementation injections also have been used to treat adhesive capsulitis. Hydrodilatation, also known as distension arthrography, involves an injection into the glenohumeral joint under pressure and has been utilized to treat adhesive capsulitis with the intent to rupture contractures. Hydrodilatation has been performed and accomplished variously as an isolated intervention, accompanied by arthrography, or accompanied by manipulation under anesthesia, as well as with arthroscopy.

See also Rotator Cuff Tendinopathy.

GLUCOCORTICOID INJECTIONS FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Glucocorticoid injections are strongly recommended for treatment of adhesive capsulitis.
Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

Indications

Moderate or severe adhesive capsulitis (Loew et al., 2005), or mild cases with insufficient control or progression. Generally, at least 2-3 weeks of exercise without evidence of improvement would be indicated prior to injection due to the natural tendency to improve.

Benefits

Improved pain and range of motion

Harms

Rare infection, lack of response, short term worsened diabetic control

Frequency/Dose/Duration

One injection, one set of injections (both intraarticular and Subacromial (Cho C-H, 2016) or one set of injections at three sites (posterior capsule, subacromial and subcoracoid) (Pushpasekaran et al., 2017) is recommended. The results should be assessed prior to another potential injection(s). Variable approaches have been used, as injections have been performed in the:

(1) glenohumeral joint (Jacobs et al., 2009)
(2) subacromial space (Valtonen, 1974) (De Jong et al., 1998),
(3) using 2 injection points (Ryans et al., 2005), as well as
(4) targeting the shoulder capsule (Dacre et al., 1989).

One trial suggested no differences in outcomes between bursal injections and intra-articular injections (Rizk et al., 1991). There are no quality trials comparing these different approaches.
A second injection may be reasonable, particularly if the initial results are partial but insufficient. Subsequent injection(s) should generally be based on objective evidence of progress attributable to the injection(s), but with insufficient or incomplete results. If an initial injection is unsuccessful, another injection with a different approach is suggested. A third injection is not recommended if there is not objective response to the 2 prior injections.

An injection is recommended to be combined with exercises (Carette et al., 2003).

Quality trials have utilized:

- Triamcinolone hexacetonide 40mg (Carette et al., 2003),
- Triamcinolone acetonide 10mg (De Jong et al., 1998) (see note immediately below),
- Triamcinolone acetonide 20mg (Yoon et al., 2013) and
- Triamcinolone acetonide 40mg (van der Windt et al., 1998) (De Jong et al., 1998) (Yoon et al., 2013).

One high-quality trial suggested triamcinolone acetonide 10mg was inferior to 40mg, thus, triamcinolone acetonide 40mg is the recommended dose for that glucocorticoid (De Jong et al., 1998).

Trials have both used:

(i) fluoroscopy (Carette et al., 2003),

(ii) ultrasound (Lee et al., 2009), and
(iii) no imaging for the injection(s).

There is only one study suggesting better results with ultrasound than blind injections (Lee et al., 2009), resulting in limited evidence on the question of the utility and/or need of imaging. Thus, both blind and image-guided injections are acceptable.

Indications for Discontinuation

Recovery, plateau in recovery, intolerance.

Rationale

There are multiple high- and moderate-quality trials that have evaluated glucocorticoid injections for treatment of adhesive capsulitis. The highest quality trial found the injection group or the injection plus physiotherapy groups to be superior to the saline injection group or the saline group plus physiotherapy (Carette et al., 2003). The next highest quality trial suggests injections are more effective than physiotherapy (Ryans et al., 2005). Other studies have found no differences in corticosteroid injections compared with NSAID (Dehghan et al., 2013) and hyaluranoic acid (Park et al., 2013). A quality trial suggested superior results with injection compared with oral steroids (Widiastuti-Samekto et al., 2004). Two studies conflict regarding superiority compared with NSAIDs (Shin et al., 2013, Dehghan et al., 2013). One trial suggested combined intraarticular and subacromial steroid injection was superior, suggesting the subacromial space was contributory to the pathology and that a combined approach should be used (Cho C-H, 2016). Steroid injections are invasive, have some adverse effects, and are moderately costly. However, they appear quite effective and thus are recommended for treatment of adhesive capsulitis. Injection should be combined with range of motion and other exercises for the best results (Carette et al., 2003).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Subacromial Glucocorticosteroid Injections, Subacromial Glucocorticoid Injections; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 31 articles in PubMed, 340 in Scopus, 1 in CINAHL, 10 in Cochrane Library, 308 in Google Scholar, and 22 from other sources†. We considered for inclusion 3 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 22 from other sources. Of the 29 articles considered for inclusion, 24 randomized trials and 4 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SUPRASCAPULAR NERVE BLOCKS FOR TREATMENT OF ADHESIVE CAPSULITIS

Recommended

Suprascapular nerve blocks are recommended for treatment of adhesive capsulitis.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Adhesive capsulitis, moderate or severe cases; failure of adequate response with NSAIDs, exercises, and glucocorticosteroid injection(s).

Benefits

Improved pain and range of motion

Harms

Failure to improve and medicalization

Frequency/Dose/Duration

One block is recommended and results assessed. Patients should be given range of motion and conditioning exercises to perform (Dahan et al., 2000). A second block may be recommended if there is a partial, but inadequate response to initial block. The quality trial utilized bupivacaine 0.5%, 10mL.

Rationale

One moderate-quality trial suggests suprascapular nerve block efficacy compared with a placebo block for treatment of adhesive capsulitis (Dahan et al., 2000). A trial suggested equivalence between a steroid injection and a block (Verma et al., 2019). Another trial that included rehabilitation therapy in both groups, found mostly equivalence between steroid injection and nerve block (Parashar et al., 2021) One trial suggested modest additive benefit of nerve block to PT (Klç et al., 2015). Nerve blocks are invasive, have adverse effects, and are of moderate cost; however, a block is recommended for select patients who have inadequate results with NSAID, exercise, PT and steroid injection.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Suprascapular Nerve Blocks OR SSNB; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 22 articles in PubMed, 141 in Scopus, 7 in CINAHL, 21 in Cochrane Library, 841 in Google Scholar, and 1 from other sources†. We considered for inclusion 4 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 1 from other sources. Of the 9 articles considered for inclusion, 6 randomized trials and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms.

Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

VISCOSUPPLEMENTATION FOR ADHESIVE CAPSULITIS

Recommended

There is no recommendation for viscosupplementation injections for the treatment of adhesive capsulitis.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no placebo-controlled trials. One comparative trial found equivalence between one steroid injection and a series of 3 hyaluronate injections (Lim et al., 2014). Another 4-arm trial found physical therapy was the best treatment (Calis M, 2006). As there are no quality data defining efficacy, and one trial suggested one steroid injection was equivalent to 3 hyaluronate injections, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: viscosupplementation, hyaluronic acid, hyaluronan; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 22 articles in PubMed, 102 in Scopus, 8 in CINAHL, 14 in Cochrane Library, 3530 in Google Scholar, and 0 from other sources†. We considered for inclusion 6 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 8 articles considered for inclusion, 4 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PLATELET RICH PLASMA (PRP) FOR ADHESIVE CAPSULITIS

Recommended

PRP injections are selectively recommended for treatment of adhesive capsulitis
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Moderate to severe adhesive capsulitis, having insufficient results with exercises, and steroid injection (generally at least several weeks after a steroid injection which suppresses the inflammation that the PRP intentionally seeks to produce).

Benefits

Improvement in ROM and reduced pain

Harms

Increased pain, infection, allergic reaction, blood clots

Frequency/Dose/Duration

A total of three injections given two weeks apart has been used in both placebo-controlled trials (Ünlü et al., 2021) (Lin, 2018).

Indications for Discontinuation

Severe adverse effect, allergic reaction, intolerance.

Rationale

There are multiple RCTS involving PRP injections. Two modest-sized trials suggest superiority of PRP to placebo (Ünlü et al., 2021) (Lin, 2018). However, a comparative trial found no superiority to physical therapy (Thu et al., 2020). PRP injections have not worked well for many disorders, raising concerns about this relatively sparse literature base. With two trials suggesting some efficacy, PRP injections are selectively recommended for use in patients who have inadequate results with exercises, therapy and steroid injection.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Platelet-rich Plasma Injections OR PRP; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 15 articles in PubMed, 48 in Scopus, 5 in CINAHL, 19 in Cochrane Library, 1,140 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

HYDRODILATATION FOR TREATMENT OF ADHESIVE CAPSULITIS IN SELECT PATIENTS

Recommended

Hydrodilatation is selectively recommended for treatment of adhesive capsulitis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Adhesive capsulitis, especially moderate to severely affected patients with pain and loss of motion. Should be reserved for patients who do not respond sufficiently to NSAIDs, exercises, and steroid injection(s) (Loew et al., 2005).

Benefits

Potential to improve the adhesive capsulitis

Harms

Rare infection, increased pain, failure to improve the adhesive capsulitis

Frequency/Dose/Duration

If there is no improvement after one procedure, a second would not be recommended. If there objectively improved range of motion with one procedure but an incomplete response, a second may be selectively indicated to attempt to achieve a complete resolution.

Rationale

Hydrodilatation has been evaluated in multiple moderate-quality trials, with and without arthrography, usually accompanied by steroid instillation. Results of these studies conflict. One moderate-quality trial suggests hydrodilatation was ineffective compared with a sham (Bennell et al., 2007), and has been interpreted as corroborative evidence that the natural course is towards resolution. A moderate-quality trial found distension superior to glucocorticosteroid injection (Gam et al., 1998), although another trial found a lack of such benefit (Paruthikunnan et al., 2020). Another moderate-quality trial suggested arthrographic distension was superior to physiotherapy alone (Khan et al., 2005). A comparative trial suggested arthroscopic release was superior to dilatation (Gallacher S, 2018). On balance, these studies somewhat conflict, but overall appear to suggest that hydrodilatation may be effective, if inferior to arthroscopic release (Gallacher S, 2018). Hydrodilatation is invasive, has adverse effects, and is of moderate to high cost. However, it is recommended for select patients in whom less invasive treatments, including injections, have failed to provide sufficient treatment.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Hydrodilatation; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized

controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 24 articles in PubMed, 238 in Scopus, 11 in CINAHL, 30 in Cochrane Library, 608 in Google Scholar, and 0 from other sources†. We considered for inclusion 6 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 911 articles considered for inclusion, 6 randomized trials and 2 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.6.7. SURGICAL CONSIDERATIONS

Arthroscopy for diagnostic purposes, as well as to release contractures associated with the disorder and/or manipulation under anesthesia, has been used to evaluate and treat patients with adhesive capsulitis. Arthroscopy has also been combined with hydrodilatation. Open release of contractures also has been used to treat patients with adhesive capsulitis.

ARTHROSCOPIC SURGERY FOR ADHESIVE CAPSULITIS

Recommended

Arthroscopy is recommended for evaluation of select patients with adhesive capsulitis, including subsequent, definitive operative approaches.
Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

Adhesive capsulitis in severely affected patients with pain and loss of motion who do not respond sufficiently to NSAIDs, exercise, injection(s), and potentially to hydrodilatation or MUA and in whom there is believed to be a remediable, intra-articular or periarticular defect that is able to be addressed surgically (Wiley, 1991) (Ogilvie-Harris et al., 1995) (Andersen et al., 1998) (Loew et al., 2005) (Pollock et al., 1994) (Uitvlugt et al., 1993) (Andersen et al., 1996), including:

- rotator cuff tear with surgical indications and the expectation that surgical treatment will immediately follow arthroscopy (see below);
- labral tear with surgical indications (see below);
- impingement syndrome with surgical indications (see below);
- glenohumeral instability,
- recurrent dislocations,
- other moderate or severe shoulder joint pain, or
- acromioclavicular arthritis.

Benefits

Diagnostic confirmation and the opportunity for definitive treatment

Harms

Infections, operative complications

Frequency/Dose/Duration

Arthroscopy would rarely be repeated other than for new
Indications

Rationale

There are no sham-controlled trials. However, two trials suggest superiority of arthroscopic surgical release compared with glucocorticoid injection (Qi Zhu, 2019) (Mukherjee et al., 2017). Arthroscopy also has particular advantages to address co-exiting and potentially contributing conditions (e.g., rotator cuff tear, labral tear). Arthroscopy is invasive, has adverse effects and is high cost. However, in select patients there may be no other option for addressing adhesive capsulitis particularly if a patient is not responding to non-operative and minimally invasive care. Thus, arthroscopy is selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Arthroscopic Surgery, Arthroscopy; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 230 articles in PubMed, 2545 in Scopus, 73 in CINAHL, 85 in Cochrane Library, 8850 in Google Scholar, and 0 from other sources†. We considered for inclusion 16 from PubMed, 13 from Scopus, 2 from CINAHL, 3 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 33 articles considered for inclusion, 4 randomized trials and 4 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

OPEN RELEASE OF CONTRACTURES FOR SELECT PATIENTS WITH ADHESIVE CAPSULITIS

Recommended

Open release surgery is selectively recommended for patients with adhesive capsulitis.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Adhesive capsulitis, especially severely affected patients with pain and limited range of motion who do not respond sufficiently to NSAIDs, injection(s), exercise, hydrodilatation, manipulation under

anesthesia and generally only if there is another coexistent disorder that is felt to require open surgical procedure(s) to resolve (Loew et al., 2005).

Benefits

Potential to improve the range of motion and other limitations associated with adhesive capsulitis.

Harms

Further medicalize and failure to realize material improvements

Frequency/Dose/Duration

If there is no success with one surgical approach, there would generally be no indication to repeat the procedure(s)

Rationale

There are no quality trials of open release of contractures from adhesive capsulitis. Open surgical procedures are invasive, have adverse effects, and are highly costly. They may be indicated for highly select use, mostly for those believed to have a defined, resolvable process that can be addressed through an open procedure (e.g., rotator cuff tear). Thus, they are indicated for select purposes.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Open Release of Contractures OR Open surgical release of contractures; adhesive capsulitis, frozen shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 3 articles in PubMed, 10 in Scopus, 10 in CINAHL, 3 in Cochrane Library, 3000 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 0 randomized trials and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

8.6.8. FOLLOW-UP VISITS

Patients with adhesive capsulitis often require many follow-up appointments, particularly if they are undergoing active treatments, need assistance with advancing a course of exercises, and/or require significant work limitations that need frequent adjustments. Frequencies of appointments may also be greater when more workplace limitations are required, and job demands are greater. In the few patients who undergo surgical procedures, post-operative rehabilitation can be considerable,

particularly in older patients with other associated injuries such as rotator cuff injuries. In those cases, the patient may require therapy on a prolonged basis including to manage/ progress the home exercise program and patient reassurance/ education in order to recover as much function as possible.

9. THORACIC OUTLET SYNDROME

9.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing thoracic outlet syndrome from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

Category	Recommendation	Evidence
Allied Health	Acupuncture for Chronic Pain from Thoracic Outlet Syndrome	No Recommendation, Insufficient Evidence (I)
	Other Modalities for Treatment of Thoracic Outlet Syndrome	No Recommendation, Insufficient Evidence (I)
	Physical Therapy for Thoracic Outlet Syndrome	No Recommendation, Insufficient Evidence (I)
Devices	Magnets for Treatment of Thoracic Outlet Syndrome	Not Recommended, Insufficient Evidence (I)
	Taping for Treatment of Thoracic Outlet Syndrome	Not Recommended, Insufficient Evidence (I)
Diagnostic Tests	CT for Evaluation of Thoracic Outlet Syndrome	Recommended, Evidence (C)
	Electromyography for Thoracic Outlet Syndrome	Recommended, Insufficient Evidence (I)
	MRI for Thoracic Outlet Syndrome	Recommended, Evidence (C)
	Single Proton Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET)	No Recommendation, Insufficient Evidence (I)
	Ultrasound for Thoracic Outlet Syndrome	No Recommendation, Insufficient Evidence (I)

Category	Recommendation	Evidence
	X-rays for Thoracic Outlet Syndrome	Recommended, Insufficient Evidence (I)
Electrical	Interferential Therapy for Treatment of Thoracic Outlet Syndrome	Not Recommended, Insufficient Evidence (I)
	Pulsed Electromagnetic Frequency for Treatment of Thoracic Outlet Syndrome	Not Recommended, Insufficient Evidence (I)
Exercise	Exercise for Thoracic Outlet Syndrome	Recommended, Insufficient Evidence (I)
Ice and Heat	Self-applications of Heat and Ice for Thoracic Outlet Syndrome	No Recommendation, Insufficient Evidence (I)
Injections	Injections for Treatment of Thoracic Outlet Syndrome	Recommended, Insufficient Evidence (I)
Medications	Over-the-Counter Analgesics for Thoracic Outlet Syndrome	No Recommendation, Insufficient Evidence (I)
Surgery	Surgery for Treatment of Thoracic Outlet Syndrome	Recommended, Insufficient Evidence (I)

9.2. OVERVIEW

Thoracic outlet syndrome (TOS) is one of the most controversial entrapment syndromes (1374,1876,1877,1375,1878,1879,1880,851,1881,1882,1373) with some experts questioning its existence, particularly the “disputed” form of TOS (1374,1877,801,802,1883).

Thoracic outlet syndrome involves compression of the neurological or vascular structures connecting the arm to the torso due to any cause (1876). Syndrome labels that have been used and causes include cervical rib syndrome, costoclavicular syndrome, first thoracic rib syndrome, scalenus anticus syndrome, hyperabduction syndrome, cervicobrachial neurovascular compression syndrome, shoulder-arm syndrome, hyperextension-hyperflexion cervical injury, brachial plexus adhesions, clavicular fracture malunion, effort vein thrombosis syndrome, macromastia, pneumatic hammer syndrome, brachial plexus syndrome, Adson’s syndrome, Paget-Schroetter syndrome, shoulder-girdle syndrome, fractured clavicle syndrome, cervical brachial compression syndrome, pectoralis minor syndrome, humeral head syndrome, and Rucksack (backpack) paralysis (1374,1884,1885,1886,1887,1888). The most common cause is believed to be congenital (1880).

There are 3 broad anatomic locations for compression: 1) scalene triangle; 2) costoclavicular triangle; and 3) the subcoracoid space . The scalene triangle is mostly muscular along with the first thoracic rib and transmits the nerve trunks between the scalenus muscles as well as the subclavian vein and artery near the first rib. The costoclavicular triangle is formed by the first rib, clavicle, subclavius muscle, upper border of the scapula, and subscapularis muscle. The subcoracoid space is beneath the coracoid process and is closely related to the clavipectoral fascia and costocoracoid ligament. Patients are often thought to have multiple abnormalities (1889), which adds to confusion and controversies.

Generally, when an anatomic cause of neurovascular compression includes unequivocal objective evidence of sequelae of compression, the syndrome is not controversial (1375,801,1377,1890). The vast majority of cases include vague symptoms without a clearly identifiable source of compression (e.g., cervical rib); thus, those cases are often controversial (1374,1375). Additional evidence from

cadaver studies suggests only approximately 10% of people have bilaterally normal anatomy with most individuals having anomalous bands in the thoracic outlet, raising concerns about the implications of congenital bands identified in the context of a diagnosis of TOS (1879,1891). While there are different classification schemes (1883), there are at five generally recognized TOSs (801,802,803):

1. Arterial
2. Venous
3. Traumatic neurovascular
4. True neurogenic
5. Disputed

Another classification system recognizes three TOSs: (i) compression of the brachial plexus (aka, Neurogenic TOS); (ii) compression of the subclavian vein or artery (aka, Vascular TOS); and (iii) non-specific or Disputed TOS (aka, Symptomatic TOS) (1374,1877,1377).

Either venous or arterial TOS are thought to be relatively rare, affecting approximately 5% of cases (1880,1883,1892,1893,1894,809,1895,1896), and rarely involving thrombosis (1897,1898). The majority of TOS cases are believed to have neurological symptoms and are disputed (1375,1892). Only 1 to 3% of cases are believed to have true neurogenic TOS in a C8/T1 distribution (1375,1899). Adding to the confusion is the diversity of symptoms that purportedly may include facial pain, visual disturbances, tachycardia, dyspnea, dysphagias, vertigo, tinnitus, and sleep disturbances (1880,1900,1901,1902). Many of these symptoms are also characteristic of anxiety disorders.

There are no quality epidemiological studies linking this disorder to work (1373,1903). The most commonly reported cause is congenital. It has been speculated there may be occupational physical factors associated with TOS (1904). Also, there is no consistent pattern of work tasks that has been postulated as risk factors as both heavy work and sedentary work have been proposed (1904). Similarly, overhead work is another purported factor for which quality evidence is lacking.

Although there are few quality trials for treatment (807,1905), TOS is included in the ACOEM Shoulder Disorders Guideline for informational purposes because there are patients affected with this condition who require evaluation and consideration of treatment. Non-operative treatment has been implemented for initial patient management. Surgery has been occasionally utilized for those who fail non-operative treatment (1374).

Symptoms in vascular TOS cases include reduced pulse, ischemia, venous engorgement, and edema that may vary depending on the degree of arterial and/or venous narrowing (1374,1877,1878,1890). Symptoms in many cases of neurogenic TOS include shoulder and neck pain, pain radiating into the upper extremity, muscle weakness in the upper extremity, and loss of sensation in the distribution of the affected neurological structure(s). Poorly defined, non-specific symptoms contribute to the controversial nature of, and difficulty diagnosing, disputed TOS (1375,811). The differential diagnosis of neurogenic TOS as well as disputed TOS is thought to prominently include cervical radiculopathy, cervical spondylosis, carpal tunnel syndrome, pronator syndrome, radial nerve entrapments, ulnar neuropathies, fibromyalgia, multiple sclerosis, vasculitis, and Horner's syndrome (1877,1883,1377,811,1906).

9.3. DIAGNOSTIC CRITERIA

Consensus diagnostic criteria for TOS have been published (801,802,803,804,805,806).

According to (805), **neurogenic TOS** should be defined by the presence of three of the following four criteria:

"1. LOCAL FINDINGS

a. History: Symptoms consistent with irritation or inflammation at the site of compression—scalene triangle in the case of NTOS and pectoralis insertion site in the case of NPMS—along with symptoms due to referred pain in the areas near the thoracic outlet. Patients may complain of pain in the chest wall, axilla, upper back, shoulder, trapezius region, neck, or head (including headache).

b. Examination: Pain on palpation of the affected area as above

2. PERIPHERAL FINDINGS

a. History: Arm or hand symptoms consistent with central nerve compression. Such symptoms can include numbness, pain, paresthesias, vasomotor changes, and weakness (with muscle wasting in extreme cases).

i. These peripheral symptoms are often exacerbated by maneuvers that either narrow the thoracic outlet (lifting the arms overhead) or stretch the brachial plexus (dangling; often driving or walking/running).

b. Examination: Palpation of the affected area (scalene triangle or pectoralis minor insertion site) often reproduces the peripheral symptoms.

i. Peripheral symptoms are often produced or worsened by provocative maneuvers that are believed to narrow the scalene triangle (EAST) or to stretch the brachial plexus (ULTT) (both described later).

3. ABSENCE of other reasonably likely diagnoses (cervical disk disease, shoulder disease, carpal tunnel syndrome, chronic regional pain syndrome, brachial neuritis) that might explain the majority of symptoms

4. In those who undergo it, the response to a properly performed TEST INJECTION is positive." (805)

According to (805), venous TOS should be defined by the presence of all three of the following critieria:

1. HISTORY

a. Arm swelling, usually with discoloration and heaviness

i. This can occur with the arms overhead only, suggesting nonthrombotic VTOS, or present as a fixed symptom, suggesting subclavian vein thrombosis.

b. Absence of inciting cause (indwelling catheter, malignant neoplasm)

2. EXAMINATION

a. Visible arm swelling at rest, although if the arm swelling is reported only with exertion or arms overhead, the arm may be normal at rest.

b. Arm discoloration

c. Shoulder, upper arm, or chest wall venous collaterals

3. IMAGING

a. Documentation of venous compression at the costoclavicular junction by ultrasound, venography, or cross-sectional imaging:

i. If the vein is occluded from mid upper arm to the innominate in the setting of appropriate symptoms (and no secondary cause is present), VTOS may be assumed to be present.

ii. If the vein is patent but abnormal, the location of the abnormality (costoclavicular junction or pectoralis minor space) should be documented.

iii. If the vein appears normal at rest, results of ultrasound or venography with the arm abducted >90 degrees should be reported.

iv. In all cases, every attempt should be made to obtain venography through the brachial or basilic veins rather than the cephalic vein as disease sometimes extends lateral to the cephalic arch." (805)

According to (805), "ATOS is defined as an objective abnormality of the subclavian artery caused by extrinsic compression and subsequent damage by an anomalous first rib or analogous abnormal structure (cervical rib or band) at the base of the scalene triangle. Such an abnormality can be symptomatic (ischemia or embolization) or asymptomatic (aneurysm, occlusion, or silent embolization). Loss of pulses or discoloration with provocative maneuvers in patients with NTOS does *not* mean that ATOS is present; documented injury to the subclavian artery or symptomatic arm ischemia with arms elevated must be present for this diagnosis to be made."

9.4. DIAGNOSTIC RECOMMENDATIONS

9.4.1. DIAGNOSTIC CONSIDERATIONS

There are no quality studies of diagnostic tests for any of the types of TOS; thus, an evidence-based workup protocol is not available. Specific tests are recommended to focus on the type of TOS thought to be present. For all types of TOS, x-rays are recommended. X-rays may be needed of the shoulders, neck, chest and/or thoracic spine (807). Other studies may be helpful, including MRI with contrast and CT (807). MRI with provocative maneuvers has been reported to improve the value of the MRI (808). Electrodiagnostic studies are also recommended, particularly to attempt to seek objective evidence of neurological impingement.

For vascular TOS cases, diagnostic test considerations may include duplex scanning, Doppler ultrasonography, venography, venous pressure measurements (809), arteriograms (810), coagulation studies, chest radiography, spiral CT, MRI, and ventilation / perfusion nuclear scanning. Additional studies may be required to evaluate other potential disorders in the differential, such as neoplasia.

9.4.2. ANTIBODIES

In the absence of quality evidence, it is recommended that the diagnosis of thoracic outlet syndrome be managed according to the recommendations for Rotator Cuff Tendinopathy. See Antibodies to Confirm Specific Disorders *[Recommended, Evidence (C)].*

9.4.3. NONSPECIFIC INFLAMMATORY MARKERS

In the absence of quality evidence, it is recommended that the diagnosis of thoracic outlet syndrome be managed according to the recommendations for Rotator Cuff Tendinopathy. See Non-specific Inflammatory Markers for Screening for Inflammatory Disorders in Subacute or Chronic Shoulder Pain *[Recommended, Insufficient Evidence (I)]*.

9.4.4. CYTOKINES

In the absence of quality evidence, it is recommended that the diagnosis of thoracic outlet syndrome be managed according to the recommendations for rotator cuff tendinopathy. See Cytokine Testing for Chronic Shoulder Pain *[Not Recommended, Insufficient Evidence (I)]*.

9.4.5. X-RAYS

X-rays show bony structure, are the initial test for evaluation of most cases of shoulder pain, including thoracic outlet syndrome (126,127), and have been utilized in the diagnosis of thoracic outlet syndrome (811,812).

X-RAYS FOR THORACIC OUTLET SYNDROME

Recommended

X-rays are recommended for evaluation of acute, subacute, or chronic shoulder pain.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Most patients with symptoms thought to be due to thoracic outlet syndrome are generally recommended to have x-rays obtained. X-rays may include the shoulder, cervical spine, thoracic spine, and chest.

Benefits

Diagnosis of a fracture, calcific tendinitis, or otherwise latent medical condition(s).

Harms

Medicalization or worsening of an otherwise benign shoulder condition, minor radiation exposure

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient with two to three views per body part. There is some evidence that the x-ray technique/positioning is important (Cho et al., 2012). For patients with chronic symptoms thought to be due to TOS, it may be reasonable to obtain a second set of x-rays later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

Quality studies are sparse, with one study suggesting the positioning is important to show numbers of ribs more clearly (Cho et al., 2012). X-rays may be helpful to evaluate patients thought to have TOS, both to diagnose and to assist with the differential diagnostic possibilities such as tendinoses and arthroses. X-rays are particularly helpful for diagnosis of cervical ribs, cervical spine disorders, calcific tendinitis, etc., which results in different optimal treatment approaches. X-rays are non-invasive, low to moderately costly, and have little risk of adverse effects, and therefore are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Radiography, X-Rays, Roentgenograms; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 577 articles in PubMed using

Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 577 articles, 909 in Scopus, 1 in CINAHL, 0 in Cochrane Library, 16000 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 1 diagnostic study and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.4.6. COMPUTED TOMOGRAPHY

Computerized tomography (CT) has been utilized in the diagnosis of thoracic outlet syndrome (813,814,815,816,817).

COMPUTED TOMOGRAPHY (CT) FOR EVALUATION OF THORACIC OUTLET SYNDROME

Sometimes Recommended

Computed tomography (CT) is selectively recommended for patients suspected of having thoracic outlet syndrome.
Strength of evidence Recommended, Evidence (C)
Level of confidence Moderate

Indications

Patients thought to have thoracic outlet syndrome (TOS). CT is particularly advantageous over MRI for concerns regarding osseous abnormalities and among those with contraindications for MRI (e.g., ferrous implants or foreign bodies); otherwise, MRI is thought to be superior.

Benefits

Define anatomy and potentially secure a diagnosis for the cause of the symptoms.

Harms

False positives and false negatives for rotator cuff tears.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Indications for Discontinuation

There are quality studies of the use of CT for evaluation of TOS, showing that CT was superior to x-rays for evaluating transverse process anomalies and cervical ribs (Bilbey et al., 1989). CT was shown helpful in another study that included extremity positioning (Remy-Jardin et al., 2000). CT angiography

was also shown to be helpful for vascular TOS cases (Gillet et al., 2018). Thus, CT is selectively recommended for evaluation of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Computerized Tomography, CT scans, Tomography, X-Ray Computed; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 123 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 123 articles, 106 in Scopus, 5 in CINAHL, 0 in Cochrane Library, 10300 in Google Scholar, and 0 from other sources†. We considered for inclusion 4 from PubMed, 0 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 6 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.4.7. LOCAL ANESTHETIC INJECTIONS

Local anesthetic injections and nerve blocks have potential to confirm a clinical impression. Criteria for blocks are increasingly converging on the criterion of at least an 80% reduction in symptoms that is concordant with the expected duration of the anesthetic. Diagnostic injections are also performed via the subacromial space, glenohumeral joint, and acromioclavicular joint. See Injection Therapies.

In the absence of quality evidence, it is recommended that the use of local anesthetic injections for thoracic outlet syndrome be managed according to the recommendations for neuropathic pain in the ACOEM Chronic Pain guideline. See Local Anesthetic Injections for Diagnosing Chronic Neuropathic Pain *[Recommended, Insufficient Evidence (I)]* and Nerve Blocks for Neuropathic Pain *[Recommended, Insufficient Evidence (I)]* in the ACOEM Chronic Pain guideline.

9.4.8. ELECTROMYOGRAPHY

Electrodiagnostic studies have also been used to confirm diagnostic impressions of other peripheral nerve entrapments, brachial plexopathies, and neurologic component of thoracic outlet syndrome (147,148,818,819).

See the Cervical and Thoracic Spine Disorders and Hand, Wrist, and Forearm Disorders for discussions regarding use of electrodiagnostic studies for evaluation of cervical spine and distal upper extremity-related disorders that may present as shoulder pain, including TOS.

ELECTROMYOGRAPHY FOR THORACIC OUTLET SYNDROME

Recommended

Electrodiagnostic studies are recommended to assist in the diagnosis of subacute or thoracic outlet syndrome.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Patients with subacute or chronic paresthesias with or without pain, particularly with unclear diagnosis and/or thought to potentially have thoracic outlet syndrome. EMG may be used to rule out other disorders. Failure to resolve or plateau of suspected radicular pain after waiting 4 to 6 weeks (to provide for sufficient time to potentially develop EMG abnormalities as well as time for conservative treatment to resolve the problems), equivocal imaging findings, and suspicion by history and physical examination that a neurologic condition other than radiculopathy may be present.

Benefits

Identification of neurological impingement/entrapment, neurological disorders, including radiculopathy, plexopathy and peripheral nerve entrapment

Harms

Negligible

Frequency/Dose/Duration

Generally, only one test is needed. If the test is obtained too early, a repeat study may be needed if symptoms persist or progress to ascertain whether the test becomes abnormal with time.

Rationale

There is one small study without unaffected controls that suggesting lack of efficacy of EMG studies for the evaluation of TOS (Passero et al., 1994), but no other quality studies (Vanti et al., 2007, Tolson, 2004, Tsao et al., 2014). Yet, electrodiagnostic studies appear to be capable of assisting in confirming peripheral nerve entrapments such as thoracic outlet syndrome, the long thoracic nerve and suprascapular nerve. These studies are minimally invasive, have minimal potential for adverse effects, and are of moderate to high cost depending on the extent of the testing required. Prior to considering surgery, they are recommended as the outcomes in workers' compensation patients are reportedly poor (Franklin et al., 2000, Franklin, 2013, Washington State Department of Labor and Industries, 2010).

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Electromyography, EMG; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 800 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 800 articles, 774 in Scopus, 2 in CINAHL, 2 in Cochrane Library, 4,870 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 2 from Google

Scholar, and 0 from other sources. Of the 2 articles considered for inclusion, 1 diagnostic study and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.4.9. FUNCTIONAL CAPACITY EVALUATIONS

In the absence of quality evidence, it is recommended that the diagnosis of thoracic outlet syndrome be managed according to the recommendations for Rotator Cuff Tendinopathy. See Functional Capacity Evaluations for Chronic Disabling Shoulder Pain *[Recommended, Insufficient Evidence (I)]*.

9.4.10. MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) has been utilized in the diagnosis of thoracic outlet syndrome (820,821,822,823,824,825,826,827,828).

MAGNETIC RESONANCE IMAGING (MRI) FOR THORACIC OUTLET SYNDROME

Recommended

MRI is recommended for patients suspected of having thoracic outlet syndrome (TOS).
Strength of evidence Recommended, Evidence (C)
Level of confidence Moderate

Indications

Patients thought to have thoracic outlet syndrome.

Benefits

Define anatomy and potentially secure a diagnosis for the cause of the symptoms.

Harms

False positives and false negatives for rotator cuff tears.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

Multiple trials found utility of MRI for both vascular and nervous TOS (Panegyres et al., 1993, Demondion et al., 2003, Ersoy et al., 2012), including MRA (Zhang et al., 2019). One trial found MRI

had low sensitivity but high specificity (Hardy et al., 2019), one found high sensitivity and high specificity (while another found both low sensitivity and low specificity (Singh et al., 2014). One study suggested that extremity positioning was important (Smedby et al., 2000). Thus, MRI has reasonably consistent evidence of utility of MRI in the assessment of TOS patients and is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnetic Resonance Imaging, MRI; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 142 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 142 articles, 828 in Scopus, 9 in CINAHL, 1 in Cochrane Library, 8500 in Google Scholar, and 0 from other sources†. We considered for inclusion 9 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 9 articles considered for inclusion, 9 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.4.11. ULTRASOUND

Ultrasound has been used for the diagnosis of thoracic outlet syndrome (829,830,831,832,833,834,835,836,837,838,839,840,841,842,843).

ULTRASOUND FOR THORACIC OUTLET SYNDROME

Sometimes Recommended

Doppler ultrasound is recommended to address vascular thoracic outlet syndrome. Otherwise, there is no recommendation for ultrasound as a diagnostic procedure in thoracic outlet syndrome. There are other indications for ultrasound.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

One study suggested US was able to identify fibromuscular bands (Arányi et al., 2016). One study suggested US was insufficiently precise for the evaluation of subclavian vein thrombosis (Brownie et al., 2020), although another thought there was sufficient accuracy for use regarding thromboses (Longley et al., 1992). Another study suggested insufficient operant characterizes for the use of US for arterial TOS (Bishop et al., 2021). A study suggested insufficient utility of US for neurogenic TOS (Fouasson-Chailloux et al., 2021). Doppler US is helpful to address vascular TOS and thus is recommended for that indication. Otherwise, because the studies of US conflict, there is no recommendation. There are other indications for ultrasound.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasound, Ultrasonography; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 565 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 565 articles,700 in Scopus, 4 in CINAHL, 1 in Cochrane Library, 12800 in Google Scholar, and 0 from other sources†. We considered for inclusion 3 from PubMed, 1 from Scopus, 1 from CINAHL, 0 from Cochrane Library, 11 from Google Scholar, and 0 from other sources. Of the 16 articles considered for inclusion, 9 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.4.12. SINGLE PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT) FOR THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for single-proton emission computed tomography (SPECT) for the evaluation of patients with thoracic outlet syndrome.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of thoracic outlet syndrome. Thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Single Photon Emission Computerized Tomography, Positron Emission tomography; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 6014 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 6008 articles, 679 in Scopus, 1 in CINAHL, 13 in Cochrane Library, 317 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 0 articles considered for inclusion, 0 diagnostic studies and 0 systematic reviews met the inclusion criteria. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.4.13. POSITRON EMISSION TOMOGRAPHY (PET)

POSITRON EMISSION TOMOGRAPHY (PET) FOR THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation regarding positron emission tomography (PET) scanning for the evaluation of patients with thoracic outlet syndrome.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of thoracic outlet syndrome; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Single Photon Emission Computerized Tomography, Positron Emission tomography; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 6014 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 6008 articles, 679 in Scopus, 1 in CINAHL, 13 in Cochrane Library, 317 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 0 articles considered for inclusion, 0 diagnostic studies and 0 systematic reviews met the inclusion criteria. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.5. TREATMENT RECOMMENDATIONS

9.5.1. INITIAL CARE

Initial care of TOS is based on the exact type of compression. For acute venous TOS with potential thrombus, evaluation and confirmation of the thrombus is urgent. Treatment is based on confirmation of thrombus; otherwise there usually are no urgent care requirements. For arterial TOS cases, evaluation and urgent management may be required depending on the severity of the compression and vascular impairment. Disputed TOS cases require evaluation of disparate conditions in the differential diagnosis. Initial care for suspected neurogenic or disputed TOS may include symptomatic management with over-the-counter analgesics, self-applications of heat and ice.

OVER-THE-COUNTER ANALGESICS FOR THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for over-the-counter (OTC) analgesics for thoracic outlet syndrome.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies of OTC analgesics and thus there is no recommendation. However, self-use of these medications that have very low hazard potential may be reasonable.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: OTC Analgesics, Over the Counter Analgesics, Acetaminophen, NSAIDS; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 111 articles in PubMed, 5 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 4040 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles fit the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SELF-APPLICATION OF HEAT FOR THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for self-application of heat for thoracic outlet syndrome.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials using heat or cryotherapies and thus there are no recommendations.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Self-Application of Heat and Ice, Heat-Cold Application; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 111 articles in PubMed, 17 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 353 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SELF-APPLICATION OF ICE FOR THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for self-application of ice for thoracic outlet syndrome.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials using heat or cryotherapies and thus there are no recommendations.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Self-Application of Heat and Ice, Heat-Cold Application; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, shoulder; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 111 articles in PubMed, 17 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 353 in Google Scholar, and 0 from other sources. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.5.2. ACTIVITY MODIFICATION AND EXERCISE

Exercise (1876,1883,1904,807,1907,1908,1909,1910,1911,1912,1913,1914) and education (1908,1911,1912,1915,1916,1917,1918,1919) are recommended. Exercise has often been prescribed (807,1907,1908,1909,1910). However, the diversity of exercise regimens with highly variable approaches underscores the lack of directed quality evidence. Some emphasize strengthening of the shoulder girdle (1876,1883,807), with most patients reporting improvement in their symptoms (1876,1910). Studies recommend rehabilitation that includes postural training (1904,1908,1920,1911,1912); exercises emphasizing stretching (1913); massage traction and isometric exercises (1921); massage and acupuncture (1922); and exercises emphasizing postural physiotherapy, including diaphragmatic breathing (1914). Evidence of efficacy is poor, and it has been suspected many patients naturally improve over time (1883). Thus, there is no recommendation for any particular exercise regimen over another.

Home exercise programs have been utilized with 88% satisfaction at 2 years in a large longitudinal case series (1907) and are recommended. Weight loss has been used as a treatment (1904,1908,1911,1915) and is recommended, particularly among patients with obesity. Psychological distress has been reportedly elevated in these patients with a suggestion for psychological care, relaxation, and endurance training (1923), which are recommended for select patients.

In the absence of quality evidence, it is recommended that neurogenic TOS and disputed TOS be treated as neuropathic pain and managed according to the recommendations in the ACOEM Chronic Pain Guideline. See Aerobic Exercise for Neuropathic Pain *[Recommended, Insufficient Evidence (I)]*, Strengthening Exercise for Neuropathic Pain *[Recommended, Insufficient Evidence (I)]*, and Aquatic Therapy for Neuropathic Pain *[Recommended, Insufficient Evidence (I)].*

EXERCISE FOR THORACIC OUTLET SYNDROME

Recommended

Exercise is recommended for thoracic outlet syndrome.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

All patients with TOS are candidates for treatment with exercises. This often requires progressive exercises under supervision of a therapist.

Benefits

Improved or resolved symptoms.

Harms

Negligible

Frequency/Dose/Duration

Different regimens may be used. Often this includes appointments 1-2 times per week for the first few weeks and then weekly appointments for several additional weeks. Additional sets of appointments

should be based on continued progressive improvements in symptoms and function while not yet achieving full recovery.

Indications for Discontinuation

Resolution, intolerance, non-compliance

Rationale

There is one trial that used stretching exercises in all groups, while using injection in one group suggesting superiority of injection (Kim et al., 2016). There are no quality trials of exercise for treatment of TOS. However, exercise appears effective for some patients (Watson et al., 2009, Povlsen et al., 2010, Hanif et al., 2007, Collins et al., 2021, Kuhn et al., 2013). Exercise is not invasive, has low adverse effects, is low to moderate in cost, and appears to have some efficacy; thus, exercise for TOS is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Exercise, Exercise Therapy, Resistance Training; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 113 articles in PubMed, 492 in Scopus, 0 in CINAHL, 23 in Cochrane Library, 14,700 in Google Scholar, and 1 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 1 from Cochrane Library, 2 from Google Scholar, and 1 from other sources. Of the 5 articles considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

WEIGHT LOSS FOR THORACIC OUTLET SYNDROME

Recommended

Weight loss is recommended for thoracic outlet syndrome, particularly among patients with obesity.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Weight loss has been used as a treatment for thoracic outlet syndrome (Parziale et al., 2000, Crosby et al., 2004, Leffert, 1991, Novak et al., 1995) and thus is recommended, particularly among patients with obesity.

PSYCHOLOGICAL INTERVENTIONS (RELAXATION AND ENDURANCE TRAINING) FOR THORACIC OUTLET SYNDROME

Recommended

Psychological care, including relaxation and endurance training, is recommended for select patients with psychological distress.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Psychological distress has been reportedly elevated in the patients with thoracic outlet syndrome. Psychological care, including relaxation and endurance training, has been suggested (Gockel et al., 1995); thus, they are recommended for select patients.

PHYSICAL THERAPY FOR THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for physical therapy for thoracic outlet syndrome. However, exercise is recommended, and it may need to be supervised by a therapist (see Exercise for Thoracic Outlet Syndrome).
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

Exercises are recommended for TOS and commonly require supervision; however, there is no recommendation for a specific discipline.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Physical Therapy, Physiotherapy, Physical Therapy Modalities; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 119 articles in PubMed, 251 in Scopus, 8 in CINAHL, 4 in Cochrane Library, 18000 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 1 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 0 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.5.3. MEDICATIONS

Arterial TOS treatment is thought to generally require surgery to address a structural defect (1877,1377,1924,1925). Medications are generally not indicated as a primary initial focus, although some use of thrombolytics and anticoagulation may be required acutely.

Acute venous TOS with documented thrombosis is often treated by anticoagulation (1926,1927,1928,1929,1930,1931,1932,1933,1934,1935) and may involve fibrinolytics depending on severity of the condition and perceived risks (1929,1933,1934,1936,1937,1938,1939,1940,1941,1942,1943,1944,1945,1946). Thrombectomy (809,1927,1947,1948) and venoplasty (1936) are options for treatment of moderate to severe clots.

True neurological TOS is thought to be largely associated with anatomic defects (1377). However, authors have required a trial of non-operative care and reserved surgical treatment for those with advancing neurological symptoms or signs (1377,1949,1950,1951,1952). For disputed TOS, the existence of the condition, evaluation, and treatment are controversial (1375). Non-operative treatments are generally the first interventions attempted (1907,1953). Specific recommendations have included NSAIDs (1908,1904), muscle relaxants (1908,1904), biofeedback (1908,1904), and anti-depressants (1904).

In the absence of quality evidence, it is recommended that neurogenic TOS and disputed TOS be treated as neuropathic pain and managed according to the recommendations in the ACOEM Chronic Pain Guideline. See the following recommendations for neuropathic pain in the ACOEM Chronic Pain Guideline:

- NSAIDs for Chronic Neuropathic Pain *[Recommended, Insufficient Evidence (I)]*
- Acetaminophen for Neuropathic Pain *[Recommended, Insufficient Evidence (I)]*
- Muscle Relaxants for Acute Exacerbations of Neuropathic Pain *[Recommended, Insufficient Evidence (I)]*
- Tricyclic, Tetracyclic, and Serotonin-Norepinephrine Reuptake Inhibitors Anti-depressants for Neuropathic Pain *[Moderately Recommended, Evidence (B)]*
- Selective Serotonin Reuptake Inhibitors and Norepinephrine-Dopamine Reuptake Inhibitors for Neuropathic Pain *[Recommended, Evidence (C)]*
- Anticonvulsant Agents for Neuropathic Pain *[Moderately Recommended, Evidence (B)]*
- Capsaicin Patches for Neuropathic Pain *[Moderately Recommended, Evidence (B)]*
- Topical NSAIDs for Chronic Neuropathic Pain *[Recommended, Evidence (C)]*
- Lidocaine Patches for Neuropathic Pain *[Moderately Recommended, Evidence (B)]*

See also the ACOEM Opioids Use guideline for recommendation on the Treatment of Subacute or Chronic Severe Pain *[Recommended, Insufficient Evidence (I)].*

9.5.4. DEVICES

Use of orthoses have been reported (844), but there are no quality trials evaluating their use. The general tendency is for the condition to improve; thus, it is unclear whether the orthosis improves the condition beyond what would otherwise occur and there is no plausible mechanism for orthoses to improve TOS.

TAPING FOR TREATMENT OF THORACIC OUTLET SYNDROME

Not Recommended

Taping is not recommended for the treatment of TOS.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy for TOS. The sole trial appears to have suffered from a randomization failure with marked differences in outcome measures at baseline between the two groups (Ortaç et al., 2020). There is evidence suggesting inefficacy for other shoulder disorders, and thus these treatments are not recommended for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Taping, Taping and Strapping, Athletic Tape; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 1 article in PubMed, 9 in Scopus, 1 in CINAHL, 1 in Cochrane Library, 2530 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic review met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MAGNETS FOR TREATMENT OF THORACIC OUTLET SYNDROME

Not Recommended

Magnets are not recommended for the treatment of TOS.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy for TOS. There is evidence suggesting inefficacy for other shoulder disorders, and thus these treatments are not recommended for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnets, Magnetic Therapy; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*,

randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 6 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 15000 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.5.5. ALLIED HEALTH INTERVENTIONS

Acupuncture and other physical methods such as massage, diathermy, and magnets have been used to treat shoulder pain that includes TOS.

ACUPUNCTURE FOR CHRONIC PAIN FROM THORACIC OUTLET SYNDROME

No Recommendation

Acupuncture is neither recommended nor not recommended to control chronic pain associated with thoracic outlet syndrome (TOS)
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no trials for TOS; thus, acupuncture is neither recommended nor not recommended for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Acupuncture; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 0 articles in PubMed, 41 in Scopus, 18 in CINAHL, 0 in Cochrane Library, 2000 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

DIATHERMY FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of diathermy for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of diathermy for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Diathermy; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 11 articles in PubMed, 1687 in Scopus, in 0 CINAHL, 30 in Cochrane Library, 739 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INFRARED THERAPY FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of infrared therapy for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of infrared therapy for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Infrared Therapy; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We

found and reviewed 112 articles in PubMed, 773 in Scopus, 27 in CINAHL, 0 in Cochrane Library, 6600 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ULTRASOUND FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of ultrasound for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of ultrasound for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasonography, Ultrasonic therapy, Therapeutic Ultrasound; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 129 articles in PubMed, 303 in Scopus, 3 in CINAHL, 6 in Cochrane Library, 5820 in Google Scholar, and 0 from other sources†. We considered for inclusion 5 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 5 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

LASER THERAPY FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of laser therapy for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of laser therapy for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Laser Therapy, LLLT, Low Level Laser Therapy; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 111 articles in PubMed, 12 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 7990 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANUAL THERAPY FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of manual therapy for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of manual therapy for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Manual Therapy, Manipulative Therapy, Musculoskeletal Manipulations; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 112 articles in PubMed, 116 in Scopus, 2 in CINAHL, 6 in Cochrane Library, 7000 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 0 systematic reviews met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MOBILIZATION FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of mobilization for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of mobilization for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Mobilization, Musculoskeletal Manipulation, Manipulation; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 111 articles in PubMed, 620 in Scopus, 0 in CINAHL, 3 in Cochrane Library, 10,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANIPULATION FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of manipulation for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of manipulation for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Mobilization, Musculoskeletal Manipulation, Manipulation; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials,

random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 111 articles in PubMed, 620 in Scopus, 0 in CINAHL, 3 in Cochrane Library, 10,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MASSAGE FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of massage for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of massage for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Massage; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 111 articles in PubMed, 58 in Scopus, 10 in CINAHL, 2 in Cochrane Library, 4360 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

HIGH-VOLTAGE GALVANIC STIMULATION FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of high-voltage galvanic stimulation for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of the high-voltage galvanic stimulation for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: High Voltage Galvanic Stimulation, High Voltage Galvanic, High Voltage Pulsed Galvanic Stimulation; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 111 articles in PubMed, 5 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 38 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

H-WAVE® DEVICE STIMULATION FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of H-Wave® Device stimulation for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of H-Wave® Device stimulation for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: H-Wave Stimulation, H-Wave Device; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 111 articles in PubMed, 0 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 1 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

IONTOPHORESIS FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of iontophoresis for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of iontophoresis for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Iontophoresis; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 11 articles in PubMed, 48 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 471 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MICROCURRENT STIMULATION FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of microcurrent stimulation for the treatment of TOS.

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of microcurrent stimulation for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Microcurrent; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 111 articles in PubMed, 8 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 48 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PERCUTANEOUS ELECTRICAL NERVE STIMULATION (PENS) FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of percutaneous electrical nerve stimulation (PENS) for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of percutaneous electrical nerve stimulation (PENS) for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Percutaneous electrical nerve stimulation (PENS); Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 113 articles in PubMed, 0 in Scopus, 4 in CINAHL, 0 in Cochrane Library, 304 in Google Scholar, and 0 from other sources†. We considered for

inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SYMPATHETIC ELECTROTHERAPY FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of sympathetic electrotherapy for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of sympathetic electrotherapy for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Sympathetic Electrotherapy; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 111 articles in PubMed, 1 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 186 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TRANSCUTANEOUS ELECTRICAL STIMULATION (TENS) FOR TREATMENT OF THORACIC OUTLET SYNDROME

No Recommendation

There is no recommendation for or against the use of transcutaneous electrical stimulation (TENS) for the treatment of TOS.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of transcutaneous electrical stimulation (TENS) for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Transcutaneous Electric Nerve Stimulation, TENS; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 111 articles in PubMed, 0 in Scopus, 0 in CINAHL, 1 in Cochrane Library, 1880 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.
† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PULSED ELECTROMAGNETIC FREQUENCY FOR TREATMENT OF THORACIC OUTLET SYNDROME

Not Recommended

Pulsed electromagnetic frequency is not recommended for the treatment of TOS.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy for TOS. There is evidence suggesting inefficacy for other shoulder disorders, and thus these treatments are not recommended for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Pulsed Electromagnetic Frequency; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 112 articles in PubMed, 0 in Scopus, 0 in CINAHL, 199 in Cochrane Library, 6150 in Google Scholar. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INTERFERENTIAL THERAPY FOR TREATMENT OF THORACIC OUTLET SYNDROME

Not Recommended

There is no quality evidence of efficacy for TOS. There is evidence suggesting inefficacy for other shoulder disorders, and thus these treatments are not recommended for treatment of TOS.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy for TOS. There is evidence suggesting inefficacy for other shoulder disorders, and thus these treatments are not recommended for treatment of TOS.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Interferential Therapy, Electrical Stimulation Therapy; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 111 articles in PubMed, 19 in Scopus, 0 in CINAHL, 102 in Cochrane Library, 167 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.5.6. INJECTION THERAPIES

Injections have been used to treat thoracic outlet syndrome (845,846,847,848,849,850). Diagnostic injections, particularly of the subacromial space, glenohumeral joint, and acromioclavicular joint, are sometimes performed. However, when indicated, they are nearly always performed in combination with a therapeutic intervention, such as a glucocorticosteroid injection. Injection with a therapeutic agent is nearly always preferable due to less overall invasiveness with 1 injection rather than 2, as well as the potential to assess the patient both immediately post-injection for diagnostic purposes as well as longer term for therapeutic purposes.

See the Injections for Trigger Points recommendations in this guideline.

See also the following recommendations on injection therapies in the ACOEM Chronic Pain Guideline:

- Corticosteroids for Neuropathic Pain *[No Recommendation, Insufficient Evidence (I)]*
- Immunoglobulin for Neuropathic Pain *[No Recommendation, Insufficient Evidence (I)]*
- Ketamine Infusion for Neuropathic Pain *[No Recommendation, Insufficient Evidence (I)]*

- Lidocaine Infusion for Neuropathic Pain *[No Recommendation, Insufficient Evidence (I)]*
- Intravenous Phenytoin for Neuropathic Pain *[No Recommendation, Insufficient Evidence (I)]*
- Intravenous Adenosine for Neuropathic Pain *[Not Recommended, Insufficient Evidence (I)]*
- Monoclonal Antibody Injections for Neuropathic Pain *[No Recommendation, Insufficient Evidence (I)]*
- Dorsal Ganglion Destruction for Neuropathic Pain *[Not Recommended, Insufficient Evidence (I)]*

INJECTIONS FOR THE COMBINED DIAGNOSIS AND TREATMENT OF THORACIC OUTLET SYNDROME

Sometimes Recommended

Injections are selectively recommended for the combined diagnosis and treatment of TOS.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Diagnostic uncertainty and/or persistent symptoms with functional impairment. Generally, an injection would be recommended to be performed for both diagnostic and therapeutic purposes by including a glucocorticoid in the injectant.

Benefits

Assistance with securing a diagnosis and potential improvement in symptoms and impairment.

Harms

Potential injury to vascular and nervous structures. Complications of steroid injections include modestly increased risk of infection, glucose intolerance.

Frequency/Dose/Duration

Generally only one injection. A second injection with steroid may be indicated for treatment of those who developed significant benefit but among whom symptoms re-developed.

Rationale

There are few quality trials of injections for thoracic outlet syndrome. One small crossover trial comparing exercise with steroid injection in the scalene muscles suggested efficacy of the steroid injection (Kim et al., 2016), although there was no long-term follow up. Another trial suggested ropivacaine injections in the scalene muscles have modest efficacy (Rached et al., 2019). One high-quality trial found a lack of efficacy of botulinum injections (Finlayson et al., 2011). Injections are invasive, have some adverse effects, are moderate to high cost, have limited evidence of efficacy and thus are selectively recommended particularly with a combined anesthetic and glucocorticosteroid.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Injections; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials,

randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 120 articles in PubMed, 431 in Scopus, 6 in CINAHL, 3 in Cochrane Library, 3 in Google Scholar, and 1 from other sources†. We considered for inclusion 4 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 1 from other sources. Of the 8 articles considered for inclusion, 3 randomized trials and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.5.7. SURGICAL CONSIDERATIONS

Patients with vascular TOS, especially arterial, are thought to have surgical indications. Additionally, surgery is often considered for patients with venous TOS. Chronic venous symptoms are typically treated with non-operative treatments including exercises, avoiding exacerbating symptoms and surgical treatments only if symptoms are sufficiently severe and non-operative means are unsuccessful. Surgical treatments for intrinsic venous obstruction include endovenectomy (1932,1933,1954)(1955), patch graft, or venous bypass (809,1932,1954,1956,1957,1958,1959). As mentioned above, thrombectomy and venoplasty are options for treatment of moderate to severe clots. Surgical treatments for extrinsic compression include first rib resection (1933,1935,1938,1939,1940,1945,1958,1960,1961,1962,1963,1964,1965,1966,1967,1968), clavulectomy (1933,1957,1960,1962,1969,1970), or costoclavicular ligament and subclavius muscle division (809,1957,1962,1968,1971,1972,1973).

For neurogenic TOS and, particularly disputed TOS, surgical treatment has been considered controversial. Prior to considering surgery, treatment should consist of a supervised exercise and postural program with documented compliance from at least 3 months (1904) and either a documented failure to improve or insufficient improvements (1910). Impairment of work or activities of daily living should also be present (1974).

Surgery for neurogenic TOS has most often involved resection of either a cervical rib or the first thoracic rib via supraclavicular, infraclavicular or transaxillary approaches (1374,1975,1976,1977,1978,1979,1980,1981,1982,1983). Additional operative procedures include neurolysis (1374), fasciectomy (1374), and scalenectomy or scalenotomy (1984,1985,1986). The only RCT is of low quality, although it suggests transaxillary rib resection was superior to supraclavicular neuroplasty of the brachial plexus (1987).

Some studies report excellent or good post-operative results in approximately 80% of patients (1952,853,1982,1984). However, post-surgical prognoses of disputed TOS in a workers' compensation population is reportedly poor (852,853) with a population-based study reporting 60% remaining disabled from work at 1 year after surgery (851). Similar relatively poor surgical results have been reported in a pain clinic treating patients who sustained their injuries in motor vehicle crashes with 47% reporting very good pain relief vs. 20% with non-operative treatment (1988), as well as a study that found trauma similarly conveyed a worse prognosis . Surgical complications are high; these procedures are sources of malpractice exposure (1904). A considerable minority of patients undergoing surgery redevelop symptoms, estimated at 15 to 30% (809,1989).

SURGERY FOR TREATMENT OF THORACIC OUTLET SYNDROME

Recommended

Surgery is recommended for treatment of thoracic outlet syndrome.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Clearly identifiable and significantly symptomatic anatomical abnormality, including cervical ribs and other constrictive anatomic structure(s). Candidates for surgery should also have functional impairments. A minimum of 3 months of progressive, active exercises should be prescribed and failed. Arterial TOS generally needs earlier surgical intervention. As outcomes are considerably worse, surgery for disputed TOS is not recommended. Careful consideration is required to address the potential need for a second surgery.

Benefits

Improved pain and function

Harms

Lack of improvement or worsening pain, increasing impairment and disability (George et al., 2021)

Frequency/Dose/Duration

In general, surgery should not be repeated. A second surgery may be necessary after careful consideration if there are clearly identifiable and surgically treatable goals.

Rationale

There is one surgical trial of different combinations of procedures; however, there was no non-operatively managed group, non-treatment group, or sham-surgery control (Goeteyn et al., 2020). Thus, there is no quality study on which to develop surgical treatment guidance. Yet, surgery appears reasonable and potentially effective for those with clearly identifiable and significantly symptomatic anatomical abnormality(ies), including cervical ribs, other constrictive anatomic structure(s), and/or other objective evidence of impaired limb function(s) (Chapman et al., 2021, Ann Freischlag, 2018, Henry et al., 2015, Yin et al., 2019, Cook et al., 2021). Candidates for surgery should also have functional impairments. Thus, surgery for TOS is selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed, Scopus, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Surgical Procedures Operative, Surgery, Surgery Operative; Thoracic Outlet Syndrome, Thoracic Outlet Compression Syndrome, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 172 articles in PubMed, 1502 in Scopus, 0 in CINAHL, 0 in Cochrane Library, 25,000 in Google Scholar, and 1 from other sources†. We considered for inclusion 3 from PubMed, 3 from Scopus, 0 from CINAHL, 0 from Cochrane Library, 0 from Google

Scholar, and 1 from other sources. Of the 7 articles considered for inclusion, 2 randomized trials and 5 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

9.5.8. FOLLOW-UP VISITS

Patients with TOS generally require at least a few, and generally many, follow-up appointments for purposes of performing diagnostic tests, monitoring symptoms and signs for consistent findings, evaluating and advancing treatment, and gradually reducing limitations if the progress allows. Patients with slower resolution, those in need of operative care, or those with other accompanying disorders will require considerably greater numbers of appointments. Frequencies of appointments may also be greater where workplace limitations are required and job demands are higher. Postoperative rehabilitation can be considerable, particularly in disputed TOS cases with workers compensation (851,852,853). In those cases, there may be a requirement for therapy on a prolonged basis to recover as much function as possible.

10. PECTORAL STRAINS AND TEARS

10.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing pectoral strains and tears from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

Category	Recommendation	Evidence
Diagnostic Tests	CT for Evaluation of Pectoral Strains	Recommended, Insufficient Evidence (I)
	MRI for Pectoral Strains	Recommended, Evidence (C)
	Ultrasound for Pectoral Strains	Recommended, Insufficient Evidence (I)
	X-rays for Pectoral Strains	Recommended, Insufficient Evidence (I)
Surgery	Surgery for Patients with Complete Tears or Ruptures of the Pectoralis Insertion	Recommended, Insufficient Evidence (I)

10.2. OVERVIEW

Pectoral muscle tears or strains usually occur in the course of overwhelming or supramaximal force, particularly in athletes involved in weightlifting, football (854) (855), or wrestling (854) (856) (857). The most common mechanism is tear while bench-pressing heavy weights (858,859) or similar trauma with eccentric loading of the pectoralis major muscle (856). Some potentially occupational causes include straight-line parachuting, and is mostly reported in the military (860), The injury may include complete tendon avulsion of the sternal head of pectoralis major (rarely entire including clavicular head) or injury to a myotendinous or intra muscular site. The term "strain" is sometimes erroneously utilized to label virtually any muscle pain or ache, rather than the denotation of a muscle-tendon junction partial or complete disruption.

There are no quality studies evaluating treatment for these disorders. As these strains are true muscle-tendon unit strains, work/activity limitations are particularly indicated to alleviate forceful exertions while allowing sufficient time to heal the strain. For complete tears or ruptures of the pectoralis insertion, surgical repair is recommended.

10.3. DIAGNOSTIC RECOMMENDATIONS

10.3.1. X-RAYS

X-ray is the most basic of the anatomical tests. X-rays show bony structures and may be used in pectoral strains to identify bony involvement.

X-RAYS FOR PECTORAL STRAINS

Recommended

X-rays are recommended for evaluation of acute, subacute, or chronic pectoral strains.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Most patients with clinical pectoral strains.

Benefits

Diagnosis of a fracture involving the pectoral strain

Harms

Negligible

Rationale

X-rays are helpful to evaluate most patients with a pectoral strain, especially more severe cases. X-rays can help to identify bony involvement. X-rays are non-invasive, low to moderate cost, have low adverse effects, have clinical utility for this purpose, and therefore are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: pectoralis muscles sprains and strains, pectoralis muscles tears, pectoral strain, pectoral tear, pectoralis strain, pectoralis tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 53 articles in PubMed, 18,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 4 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

10.3.2. COMPUTED TOMOGRAPHY (CT)

Computed tomography is most useful for osseous imaging, whereas MRI is superior for soft-tissue imaging.

COMPUTED TOMOGRAPHY FOR EVALUATION OF PECTORAL STRAINS

Sometimes Recommended

Computed tomography (CT) is recommended for the select evaluation of pectoral strains.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

CT Imaging for pectoral strains may be selectively helpful where there is concern about bony involvement. CT is also indicated where advanced imaging is indicated but there is a contraindication for MRI (e.g., ferrous/metal implant).

Benefits

Diagnosis and understanding of the degree of bony involvement, especially in avulsion injuries.

Harms

Radiation exposure.

Frequency/Dose/Duration

Obtaining a CT once is generally sufficient. For patients with chronic pectoral strains, it may be reasonable to obtain a second CT later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

MRI is considered superior to computerized tomography for imaging most soft tissue shoulder abnormalities where advanced imaging is usually the primary concern (e.g., assessing the degree of myotendinous rupture). However, where imaging calcified structures is required, CT is considered superior. This includes bony involvement in a pectoral strain and thus CT may be selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: pectoralis muscles sprains and strains, pectoralis muscles tears, pectoral strain, pectoral tear, pectoralis strain, pectoralis tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 53 articles in PubMed, 18,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 4 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

10.3.3. FUNCTIONAL CAPACITY EVALUATIONS

See Rotator Cuff Tendinopathy.

10.3.4. MAGNETIC RESONANCE IMAGING (MRI)

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for many shoulder joint problems because it tends to be helpful for imaging soft tissues (596,598,599,594,593,600,184,592,601,597,57,595,591).

MAGNETIC RESONANCE IMAGING FOR PECTORAL STRAINS

Recommended

Magnetic resonance imaging (MRI) of the pectoralis is recommended for evaluating pectoral strains.
Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

Patients with clinically significant pectoral strains.

Benefits

Identify the severity of the pectoral strain, and help assess need of surgery (Synovec, 2020).

Harms

Negligible

Frequency/Dose/Duration

A second study is rarely needed, and should be based on significant changes in symptoms and examination.

Rationale

A comparative study with two blinded radiologists compared MRI to subsequent intraoperative assessment and reported MRI was 100% sensitive for detecting complete grade 3 tears at the sternal head and clavicular head, 93% sensitive for tendon-bone tears at the sternal head and 90% sensitive for tendon-bone tears at the clavicular head, although the sensitivites were less for detection of grade 2 tears (Chang, 2016). MRI is considered superior to CT for imaging most soft tissue shoulder abnormalities where advanced imaging is usually the primary concern (e.g., assessing the degree of

myotendinous rupture). Quality evidence suggests MRI may help determine severity of the strain and plan whether surgery is needed and thus is recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: pectoralis muscles sprains and strains, pectoralis muscles tears, pectoral strain, pectoral tear, pectoralis strain, pectoralis tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 53 articles in PubMed, 18,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 4 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 1 diagnostic and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

10.3.5. ULTRASOUND

Diagnostic ultrasound has been used for evaluating myotendinous abnormalities (188,861,186,187,184,189,185).

ULTRASOUND FOR PECTORAL STRAINS

Sometimes Recommended

Ultrasound (US) is recommended for selective use on patients suspected of having pectoral strains.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients should have symptoms and signs of a clinically significant pectoral strain. Ultrasound technicians should have sufficient skill to obviate the need for MRI or CT scanning (Boykin et al., 2010, Hanchard et al., 2013); otherwise, the test introduces unnecessary redundancy.

Benefits

Secure a diagnosis.

Harms

False positives and false negatives.

Frequency/Dose/Duration

Repeat ultrasound should be based on significant change in symptoms and/or examination findings.

Rationale

Ultrasound has been found useful in quality studies for many soft tissue disorders. There are no quality studies of pectoral strains. However, the pectoral muscles are highly accessible and imagable by US.

Ultrasound is not invasive, is of low to moderate cost, and has little risk of adverse effects; therefore, although there are concerns that MRI may be superior for imaging most shoulder soft tissues, ultrasound is recommended. The main disadvantage is the high dependency on the physician's /ultrasonographer's skills (Boykin et al., 2010, Hanchard et al., 2013). If the ultrasonographer is inexperienced or otherwise unable to accurately determine severity and/or the surgeon would nevertheless order an MRI, then US is not indicated because it would introduce needless imaging and costs.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: pectoralis muscles sprains and strains, pectoralis muscles tears, pectoral strain, pectoral tear, pectoralis strain, pectoralis tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 53 articles in PubMed, 18,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 4 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

10.4. TREATMENT RECOMMENDATIONS

SURGERY FOR COMPLETE TEARS OR RUPTURES OF THE PECTORALIS INSERTION

Recommended

Surgery is recommended for patients with complete or nearly complete tears or ruptures of the pectoralis major insertion (Bodendorfer et al., 2020).
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Severe pectoralis major strains with complete or nearly complete pectoralis muscle ruptures. Pectoralis minor tears are infrequent, and typically treated non-operatively.

Benefits

Restoration of normal shoulder function

Harms

Surgical complications, such as adhesive capsulitis, failure to heal, infections

Rationale

There are no quality trials for surgical repair of pectoral muscle ruptures. The pectoralis muscle is required for normal function, and thus surgical repair is generally indicated for completed or nearly complete/severe ruptures.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: pectoralis muscles sprains and strains, pectoralis muscles tears, pectoral strain, pectoral tear, pectoralis strain, pectoralis tear; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 53 articles in PubMed, 18,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 4 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

11. SHOULDER DISLOCATION AND INSTABILITY

11.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing shoulder dislocations and instability from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

11.2. OVERVIEW

Shoulder dislocations typically occur only after at least one traumatic event with dislocation, commonly from athletic injury or falls (1990,868). However, some dislocations may occur in the absence of trauma with conditions such as hyperlaxity (1991,1992). The general prevalence of shoulder dislocation is noted to be about equal before and after age 40 years old, although the pathophysiology and associated injuries change with advancing age. Individuals under 40 generally have dislocations due to accidents or sports (1993), with increased risk in the elderly often related to falls (1994). The primary pathology in younger patients is labral tearing and capsular stretching. With advancing age, additional pathological problems, such as associated rotator cuff tears and proximal humeral fractures, become more common.

The incidence rate ranges from 8.2-26.2/100,000 person-years (1993,1994,1334) and the lifetime cumulative incidence has been estimated at 2% (1995). The most common type of dislocation is caused by forced abduction with external rotation and results in anterior and inferior dislocation of the humeral head. Posterior dislocation of the humeral head is much less common than anterior dislocation and typically results from direct blow to the anterior shoulder (posteriorly directed force) or fall onto outstretched hand (1992). The classic presentation of a posterior glenohumeral dislocation is an internally rotated shoulder with inability to elevate or externally rotate. The anterior shoulder appears flattened and the posterior shoulder is more prominent. After an initial shoulder dislocation, recurrence is the most commonly reported sequela with rates as high as 100% in adolescent athletes (1996). Recurrences generally occur with a less traumatic event or no trauma at all. The direction of the dislocation and resultant instability is important for diagnostic purposes, as well as planning potential surgical repair (1997).

Once a shoulder has dislocated, it can be prone to symptoms of instability, termed “shoulder instability" (867). Shoulder instability is defined as pain associated with loss of shoulder function due to excessive translation of the humeral head in the glenoid fossa (867). Instability is more commonly anterior, however posterior, multi-directional and inferior instability also occur. When instability has been identified, non-operative treatment is usually recommended prior to attempted surgical repair (867).

Non-operative treatment has been traditionally recommended for anterior dislocation (1998) (1999) (2000) (2001) (2002) (2003). Yet, the risk of recurrence is estimated at 53% (1993) (1321). Some evidence supports early surgical repair after the first dislocation in younger patients in order to prevent recurrence (1990) (2004) (2005) (2006) (2007). Regardless, surgery has been traditionally utilized among patients with recurrent dislocations or among athletes (2008) (2004) (2009).

11.3. DIAGNOSTIC CRITERIA

A thorough history is important for diagnostic considerations, and should include history of prior dislocations, history of recurrent instability, documented dislocation needing reduction by a healthcare provider. Healthcare providers should obtain a history for recurrent instability with daily activities.

The literature on physical examination maneuvers for instability has limitations (420). However, the examiner should test for signs of multidirectional instability and hypermobility with sulcus sign (862). In addition, positive shoulder apprehension in the midrange of abduction (30 to 90 degrees) with limited external rotation, and anterior translation of the humeral head over the glenoid rim are suggestive of glenoid bone loss (863,864). A thorough neurovascular examination should be performed, paying special attention to the axillary nerve. Axillary nerve palsy is usually presented as a loss of shoulder abduction and loss of sensation in the proximal-lateral aspect of the arm. The arm

should be evaluated for brachial plexus injury, which is usually represented as a sensory and/or motor weakness distally in the arm (865).

The relocation, anterior release tests and apprehension signs may be used to demonstrate instability to aid diagnosis. Biceps load I and II tests and internal rotation resistance strength are thought to be more helpful for diagnosing labral lesions (866). One comparative study found the overall accuracy of 6 clinical tests (apprehension, relocation, release, anterior drawer, load and shift, and hyperabduction) to range from 80.5-86.4% compared with MRA (556). However, there are no standardized diagnostic criteria.

X-ray and MRI are used to assist in the diagnosis of shoulder dislocation or instability and/or their complications. Dislocations require plain radiograph (axillary lateral view) or CT scan to visualize the humeral head in glenoid fossa and to determine bone loss on the anterior glenoid, posterior glenoid and humeral head (Hill-Sachs and Reverse Hill-Sachs lesions). X-rays may be needed of both shoulders, particularly if there was a bilateral injury or a need for comparison with the unaffected shoulder. Other studies may be helpful, including MRI, MR arthrogram, or CT arthrogram, especially for evaluation of potential concomitant Bankart lesions or labral or rotator cuff tears (867) (868) (18).

11.4. WORK LIMITATIONS

Patients with acute dislocations are generally able to return to occupational activities; however, rates of return are generally lower for highly physically demanding jobs and athletic endeavors (869). Limitations, if needed, are gradually reduced as recovery progresses. Most workers continue to perform their job tasks while avoiding activities that provoke feelings of instability or frank dislocations even without formal restrictions. If surgery is performed, there is a similar need for workplace limitations which are gradually reduced.

11.5. DIAGNOSTIC RECOMMENDATIONS

11.5.1. X-RAYS

X-rays show bony structures and are the initial test to evaluate most cases of shoulder pain and dislocations (127) (126).

X-RAYS FOR SHOULDER DISLOCATIONS AND INSTABILITY

Recommended

X-rays are recommended for evaluation of shoulder dislocation and instability.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

All patients with shoulder dislocation and instability. X-rays help define the osseous anatomy and identify fractures for acute dislocations. X-rays of both shoulders are sometimes indicated for comparative purposes.

Benefits

Definition of the anatomy, identification of fracture, comparative anatomy if both shoulders are x-rayed.

Harms

Negligible

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient with two to three views for instability. Plain radiographs should include anterior-posterior, scapula Y-view, and if possible an axillary view to fully evaluate the bony structures. Sometimes post-relocation x-rays are obtained.

Rationale

There are no quality studies of x-rays for dislocation or instability. X-rays are helpful to identify fractures in those with acute dislocation. X-rays can help define the anatomy and comparative anatomy for the contralateral shoulder; thus, x-rays are indicated for dislocations and instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 1 diagnostic study and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

11.5.2. COMPUTED TOMOGRAPHY

Computed tomography (CT) remains an important imaging procedure, particularly for bony anatomy, whereas MRI is superior for soft tissue abnormalities. The most common pathology identified during imaging or arthroscopy is a labral tear. However, bony injury including bony Bankhart lesion, Hill-Sachs lesion, and significant glenoid bone loss that may suggest alternate treatment is often seen with CT (870,871). CT is useful in identifying shoulder joint pathology where advanced imaging of the bones is required (i.e., complex proximal humerus fracture, scapular fracture) and to evaluate the anatomy in patients with contraindication for MRI. CT scan is also indicated in patients with a history of more than one shoulder dislocation to evaluate for clinically significant glenoid bone loss and to evaluate for engaging hill-Sachs lesion which are important for surgical planning (872,873,874).

COMPUTED TOMOGRAPHY FOR EVALUATION OF SHOULDER DISLOCATIONS

Sometimes Recommended

Computed tomography (CT) is recommended for the select evaluation of dislocations with potential occult, complex proximal humeral and glenoid/scapular fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Imaging for shoulder dislocations with concerns for occult, complex proximal humeral and glenoid/scapular fractures or other calcified structures, evaluation of engaging Hill-Sachs Lesion, loose fragments, and Bony Bankhart lesion in addition to rotator cuff tear. For most shoulder conditions, MRI is superior. CT is also indicated where advanced imaging is indicated but there is a contraindication for MRI (e.g., ferrous/metal implant). CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – glenoid deficiency and humeral Hill-Sachs – because MRI is not as good for bone imaging.

Benefits

Diagnosis of occult fractures, and understanding of the degree of complex fractures, calcific tendinitis

Harms

Radiation exposure

Frequency/Dose/Duration

Obtaining a CT once is generally sufficient. For patients with chronic shoulder pain, it may be reasonable to obtain a second CT later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

MRI is considered superior to computed tomography for imaging most shoulder soft tissue abnormalities. However, where imaging calcified structures is required, CT is considered superior. This includes identifying occult fractures, complex proximal humeral and glenoid/scapular fractures. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear. A contrast CT study is minimally invasive, has few, if any, adverse effects but is costly. It is recommended for select use.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms.

Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

11.5.3. LOCAL ANESTHETIC INJECTIONS

See Rotator Cuff Tendinopathy Injections.

11.5.4. FUNCTIONAL CAPACITY EVALUATIONS

See Rotator Cuff Tendinopathy.

11.5.5. MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for many shoulder joint problems. MRI tends to be helpful for imaging soft tissues, particularly the rotator cuff, but also the joint capsule (596) (598) (599) (594) (593) (600) (184) (592) (601) (597) (57) (595) (591).

MRI FOR SHOULDER DISLOCATION AND INSTABILITY

Recommended

MRI is recommended for imaging shoulder joints after dislocation and selectively for those with instability. MRI is especially helpful for those with concerns about a concomitant rotator cuff tear.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Patients sustaining a shoulder dislocation, also selectively for those with instability. Particularly indicated for those with concerns of a concomitant rotator cuff tear. If there are concerns for labral tear, MR Arthrography is indicated instead of MRI.

Benefits

Assist in securing a diagnosis and confirming associated pathology.

Harms

False positives and false negatives for rotator cuff tears.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

There are no quality studies of MRI for shoulder dislocation or instability. MRI may be helpful to identify the degree of capsular disruption, but it is especially helpful to define rotator cuff pathology (Cartland et al., 1992) (Tirman et al., 1994) (Wnorowski et al., 1997) (Connell et al., 1999) (Tuite et al., 2000) (Tung et al., 2000) (Ardic et al., 2006) (Chang et al., 2006) (Reuss et al., 2006) (Chang et al., 2008) (Pandya et al., 2008) (McFarland et al., 2009) (Mulyadi et al., 2009), which may accompany dislocations. If there are concerns about labral tears, MR arthrography is recommended. MRI is not invasive, has negligible adverse effects, but is costly. MRI is not recommended for routine shoulder imaging but is recommended for select use after dislocation and/or instability, particularly involving concerns regarding soft tissue pathology.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 4 diagnostic articles and 0 systematic reviews met the inclusion criteria.

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11.5.6. MAGNETIC RESONANCE ARTHROGRAM

Magnetic resonance (MR) arthrography combines an MRI with an arthrogram to overcome MRI limitations and is usually performed in preference to CT arthrography unless bony structure definition is also needed (173,174). MR arthrography is particularly thought to be effective for imaging labral pathology (180) (179) (177) (175) (43) (181) (176) (178). Arthrography involves the injection of contrast into the joint. It was modified in the 1970s to include injection of air (“double contrast”) (131). Arthrography under fluoroscopy in isolation has now been almost entirely replaced by other procedures, including MRI and MR arthrography, primarily due to its low sensitivity for full-thickness tears and essentially no sensitivity for partial thickness tears (875). Most arthrograms including MR arthrogram and CT arthrogram are performed using fluoroscopy to localize the joint and inject the contrast agent.

MAGNETIC RESONANCE ARTHROGRAM FOR SHOULDER DISLOCATIONS AND INSTABILITY

Recommended

Magnetic resonance (MR) arthrography is recommended for those with dislocation and/or instability, especially for diagnosing labral tears.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Patients with dislocation and/or instability who also have symptoms or clinical suspicion of labral tears.

Benefits

Secure a diagnosis.

Harms

False positives and false negatives for labral tears. Arthrography improves the accuracy especially regarding complete rotator cuff tears and significant labral tears. Small risk of infection and complications from the injection.

Frequency/Dose/Duration

A second study is rarely needed, and should be based on significant changes in symptoms and examination.

Rationale

MR arthrograms have not been evaluated in quality studies among patients with dislocation and/or instability. Although studies are heterogeneous, pooled estimates of the sensitivity for full-thickness tears is estimated at 95% with specificity 93% (Dinnes et al., 2003). There is high prevalence for labral injury with first shoulder dislocation based on MR arthrography (MRA) (Antonio et al., 2007). A comparison of high- versus low-field MR imaging for SLAP tears among symptomatic patients found high field superior for diagnosing SLAP (Tung et al., 2000). The sensitivity of high-field MRA was 90% and specificity was 63%, while sensitivity of low-field MRA was 64% with 70% specificity. MRA was found to be superior to CT arthrography (CTA) and marginally better than MRI for identification of labral tears in a case series of patients with recurrent anterior instability, prior anterior dislocation, or shoulder pain of unknown cause (Chandnani et al., 1993). MRA sensitivity for a labral tear was 96.4%, MRI was 92.9%, and CTA was 73.1%. Specificity was 100% for all three tests; however, this appears overstated as there were only two patients without a tear in this small case series. MR arthrography is invasive, has adverse effects including a low, but definite risk of infection and is painful. It is also costly, although MRA has been felt to provide better cost effectiveness than MRI or CT arthrography for select diagnoses (Oh et al., 1999). It is likely the best imaging procedure available for patients thought to have labral tears or patients with good strength in order to assess the labrum and rotator cuff with traumatic injury simultaneously; thus, it is recommended for select use among patients with dislocation and/or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 7 diagnostic studies and 0 systematic reviews met the inclusion criteria.

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11.5.7. ULTRASOUND

Diagnostic ultrasound has been used for evaluating shoulder dislocations and instability (188) (186) (187) (184) (189) (185).

ULTRASOUND FOR SHOULDER DISLOCATIONS AND INSTABILITY

Sometimes Recommended

Ultrasound is recommended for selective use on patients with dislocation and/or instability.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Patients with shoulder dislocation and/or instability. May be helpful for evaluating concomitant rotator cuff tears. Ultrasound technicians should have sufficient skill to obviate the need for scanning (Boykin et al., 2010, Hanchard et al., 2013). Otherwise, the test introduces unnecessary redundancy and expense.

Benefits

Assist in securing a diagnosis and treatment plan.

Harms

Negligible

Frequency/Dose/Duration

Repeat ultrasound should be based on significant change in symptoms and/or examination findings.

Rationale

One moderate-quality study suggested 100% sensitivity of US for the detection of shoulder dislocation (Abbasi et al., 2013). There are no quality studies of ultrasound for dislocation or instability. Ultrasound in skilled hands may help define abnormalities, including anatomy, rotator cuff tears, and fractures. Ultrasound is not invasive, is of low to moderate cost, and has little risk of adverse effects; therefore, although there are concerns that MRI may be superior for imaging most shoulder soft tissues, ultrasound is recommended particularly for evaluation of accompanying rotator cuff tears. The main disadvantage is the high dependency on the physician's skills (Boykin et al., 2010, Hanchard

et al., 2013). If the ultrasound does not obviate the need for imaging (MRI or CT), then it introduces unnecessary expense.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 4 diagnostic studies and 0 systematic reviews met the inclusion criteria.

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11.5.8. SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

Single-proton emission computed tomography (SPECT) is a three-dimensional imaging technique.

SPECT FOR SHOULDER DISLOCATION AND INSTABILITY

Not Recommended

Single-proton emission computed tomography (SPECT) is not recommended for the evaluation of patients with shoulder disorders.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Indications

SPECT is not recommended for the evaluation of patients with shoulder disorders.

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of shoulder dislocation or instability, and they are not believed to provide significant additional information above more standard imaging techniques. Thus, they are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

11.5.9. POSITRON EMISSION TOMOGRAPHY (PET)

PET FOR SHOULDER DISLOCATION AND INSTABILITY

Not Recommended

Positron emission tomography (PET) scanning is not recommended for the evaluation of patients with shoulder disorders.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of shoulder dislocation or instability, and they are not believed to provide significant additional information above more standard imaging techniques. Thus, they are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

11.5.10. DIAGNOSTIC INJECTIONS

Diagnostic injections particularly of the subacromial space, glenohumeral joint, and acromioclavicular joint are sometimes performed. However, they are nearly always performed in combination with a therapeutic intervention, such as a ketorolac or glucocorticosteroid injection. However, a glucocorticoid injection is generally inadvisable if surgery is believed to be likely due to worse outcomes (876,877,878,879). Injection with a therapeutic agent is nearly always preferable due to less overall invasiveness with 1 injection rather than 2, as well as the potential to assess the patient both

immediately post-injection for diagnostic purposes and over the longer term for therapeutic purposes (see the recommendation for subacromial injections in Rotator Cuff Tendinopathy).

11.6. TREATMENT RECOMMENDATIONS

11.6.1. INITIAL CARE

In the absence of fractures, initial care of a dislocation involves relocation as soon as possible. Anesthesia may be required if there is sufficient muscle tightness or spasm and manual relocation is unsuccessful. The longer the time after the dislocation, the greater the probability that anesthesia will be necessary for relocation. Surgery may be required for cases with fractures. Over-the-counter analgesics and self-applications of heat and ice are recommended, and slings may be attempted for treatment acutely, with use gradually weaned.

Patients with first-time dislocation or initial instability are recommended to undergo initial immobilization with a sling for 2 to 3 weeks and early exercise program while avoiding at risk position of abduction and external rotation (880). Sling immobilization in external rotation is hypothesized to tighten the musculotendinous complex of the subscapularis, thereby closing the anterior joint cavity and reducing the labrum back to the glenoid rim in more anatomic position and improve healing of Bankhart lesion (881). Multicenter randomized clinical trial of patients with first-time dislocation suggested that the recurrence rate was significantly lower in the external rotation group (26%) than that in the internal rotation group (42%). In the subgroup of patients aged 30 years or younger, the relative risk reduction was 46.1% (882). Once the sling is discontinued, strengthening exercises under the supervision of a physical therapist are recommended (883,884).

SELF-REDUCTION FOR TREATMENT OF SHOULDER DISLOCATION

Recommended

Self-reduction of recurring shoulder dislocations is recommended for treatment of shoulder dislocation.
Strength of evidence Recommended, Evidence (C)
Level of confidence High

Indications

Patients with recurrent shoulder dislocation, especially those who delay or decline surgery

Benefits

Self-management of the dislocation. May be particularly helpful for those who are distant from medical care.

Harms

Negligible

Rationale

There are two moderate-quality randomized controlled trials, with both suggesting efficacy in teaching various methods of self-reduction to those patients who have recurrences, especially the

Milch and Boss-Holtzach-Matter techniques, with 53-55% rates of efficacy (Marcano-Fernández et al., 2018, Marcano-Fernández et al., 2020, Chechik et al., 2021). One of these trials suggest self-reduction should also be preferentially performed in the emergency department due to less pain (Marcano-Fernández et al., 2020). Thus, teaching self-reduction is a potential intervention, especially among those at risk of recurrence and especially among those without nearby assistance.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 3 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

OTC ANALGESICS FOR TREATMENT OF SHOULDER DISLOCATION

Recommended

Over-the-counter analgesics are recommended for treatment of shoulder dislocation.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Shoulder dislocation and other shoulder pain

Benefits

Self-management of the pain

Harms

Negligible for OTC analgesics unless acetaminophen doses exceed 3.5g, or the patient has liver disease or other contraindication

Frequency/Dose/Duration

Analgesics should be used per manufacturer's recommendations

Rationale

There are no quality trials evaluating analgesics for managing shoulder dislocations. However, analgesics and OTC NSAIDs are likely helpful and there is some quality evidence for the use of prescription NSAIDs for other shoulder nociceptive pain (see NSAIDs for Rotator Cuff Tendinopathy); thus, they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SELF-APPLICATION OF HEAT OR ICE FOR TREATMENT OF SHOULDER DISLOCATION

Recommended

Self-application of heat or ice is recommended for treatment of shoulder dislocation.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Shoulder dislocation and associated injuries.

Benefits

Self-management of pain

Harms

Negligible

Frequency/Dose/Duration

Ice and heat are typically used 3-5 times a day

Rationale

There are no quality trials evaluating ice or heat for managing shoulder dislocations. Self-applications of heat and ice may be helpful for self-management of symptoms, are not invasive, have low adverse effects, not costly, and are believed to be helpful for treating symptoms; thus, they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

11.6.2. ACTIVITY MODIFICATION AND EXERCISE

RANGE-OF-MOTION EXERCISES FOR SHOULDER DISLOCATIONS

Recommended

Range-of-motion exercises are recommended for treatment of patients with shoulder dislocation after relocation.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Shoulder dislocation patients, especially in the acute to subacute and/or postoperative phases. Also for those with limited range of motion (ROM) in the chronic phase. Generally, instability patients do not need range-of-motion exercises.

Benefits

Improved ROM, prevention of adhesive capsulitis. Accelerated post-operative recovery

Harms

May increase pain if aggressive range of motion is instituted, although tolerance of such may be cautiously needed if there is adhesive capsulitis to be treated or has begun to set in

Frequency/Dose/Duration

A self-directed program as tolerated (patients who also have a rotator cuff tear or labral tear often do not tolerate strenuous stretching). Supervised programs may be indicated for patients who require supervision initially or otherwise need assistance with motivation or concomitant fear avoidant belief training (see Chronic Pain and Low Back Disorders Guidelines) for a few appointments to help initiate the program.

Additional supervised appointments are indicated for patients who fail to progress or need greater

supervision, such as for ongoing fear avoidant beliefs (Ludewig et al., 2003). Dose unclear for patients with shoulder pain; common regimens of ROM exercises performed 1 to 3 times a day. For those needing a supervised program, 2-3 appointments per week for 3-4 weeks are often needed, during which strengthening exercises are added. An additional 2-4 weeks is occasionally needed to fully rehabilitate and achieve a plateau. For those who can adhere to a self-directed program, weekly appointments may suffice. Results of the exercise prescription should be regularly monitored and failure to progressively improve is an indication to either revisit the differential diagnosis and/or seek a second opinion/consultation, particularly by the time approximately 6-12 therapy appointments is reached.

Indications for Discontinuation

Achievement of normal ROM, non-compliance, development of other disorders. If normal range of motion is achieved, but further strengthening is required, additional appointments may be needed (see Strengthening Exercises).

Rationale

There are no quality studies for treatment of shoulder dislocations, postoperative rehabilitation, or instability. Range-of-motion exercises are helpful for recovery of function and prevention of adhesive capsulitis and are recommended. Transition to strengthening exercises is typically part of the rehabilitation program.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

STRENGTHENING EXERCISES FOR SHOULDER DISLOCATIONS AND INSTABILITY

Recommended

Strengthening exercises are recommended for treatment of patients with shoulder dislocations and instability.
Strength of evidence Recommended, Evidence (C)
Level of confidence Moderate

Indications

Shoulder dislocations, especially after the acute phase post-dislocation or surgery has subsided. Strengthening exercises are also indicated for patients with instability who are not thought to be surgical candidates, or decline surgery.

Benefits

Improved function and recovery. Potential to reduce instability symptoms.

Harms

May increase pain as the program progresses and with each step-up in exercise.

Frequency/Dose/Duration

A supervised treatment program is often begun with a set of appointments, e.g.: 2-3 appointments/week for 2-3 weeks. Another set of appointments may be needed for more severe cases and/or those who have not achieved treatment goals including reaching a plateau. Additional appointments should be based on documentation of ongoing, incremental functional gains. Results of the exercise prescription should be regularly monitored and failure to progressively improve is an indication to either revisit the differential diagnosis and/or seek a second opinion/consultation, particularly by the time approximately 6-12 therapy appointments is reached

Indications for Discontinuation

Achievement of normal function, reaching a plateau, development of a strain, noncompliance, failure to improve.

Rationale

One RCT suggested superiority of shoulder instability neuromuscular exercise compared with a home-based standard program for patients with a traumatic anterior shoulder dislocation (Eshoj et al., 2020). Another trial reported superiority of Watson to Rockwood exercises for multi-directional instability (Warby, 2017). There is one moderate quality experimental trial of a single appointment of exercises suggesting efficacy of glenohumeral plus scapular stabilization exercises for patients with shoulder pain, although the patients are not well characterized (Jeon et al., 2018).

Although there are few quality trials of strengthening exercises for shoulder dislocations or instability, these exercises are thought to be essential to achieve normal function. However, there is insufficient evidence to clearly define superiority of one exercise or regimen over another.

Strengthening/stabilization exercises are not invasive, have low adverse effects, and are low to moderate cost depending on the numbers of appointments. They may be high cost when performed as part of a lengthy supervised program; however, those intensive courses of therapy may be needed in some severe cases and also with cases of fear avoidant beliefs and catastrophizing.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial,

controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

11.6.3. MEDICATIONS

NSAIDs and acetaminophen are recommended for pain management for patients with shoulder dislocation. Prescription medications might be needed in moderate to severe cases. In select cases, patients may require judicious short-term use of opioids for acute pain management with a severe first dislocation (i.e., typically not beyond 3 days). Other recommended medications for pain management include muscle relaxants, capsaicin, tricyclic anti-depressants or dual reuptake inhibiting anti-depressants for chronic pain (but not SSRI antidepressants which are not effective for nociceptive pain), or gabapentin for peri-operative use. Patients with instability generally require no medication other than post-operatively.

There is no quality literature specific to shoulder dislocations or postoperative instability for nearly all of the following interventions. In the absence of quality evidence, it is recommended that shoulder dislocations and postoperative instability be managed according to the recommendations for Rotator Cuff Tendinopathy and Shoulder Pain:

- NSAIDs for Treatment of Rotator Cuff Tendinopathies and Shoulder Pain *[Strongly Recommended, Evidence (A)]*
- Acetaminophen for Acute, Subacute, Chronic, or Post-operative Shoulder Pain *[Recommended, Insufficient Evidence (I)]*
- Norepinephrine Reuptake Inhibiting Anti-depressants for Subacute or Chronic Shoulder Girdle Pain *[Recommended, Insufficient Evidence (I)]*
- Selective Serotonin Reuptake Inhibitors for Acute, Subacute, or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Anti-convulsants for Acute, Subacute or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Capsicum Creams for Acute, Subacute, Chronic Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*
- Topical NSAIDs, including Diclofenac Epolamine for Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*
- Topical Glyceryl Trinitrate, Lidocaine Patches, Eutectic Mixture of Local Anesthetics (EMLA), and Other Creams/Ointments for Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*

See also the ACOEM Opioids guideline for the treatment of subacute and chronic pain.

11.6.4. DEVICES

SLINGS, INCLUDING AN EXTERNAL ROTATION BRACE, FOR INITIAL TREATMENT ACUTELY FOR SHOULDER DISLOCATION

Recommended

Slings, especially an external rotation brace, are recommended as an option for initial treatment acutely for shoulder dislocation.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

After relocation for an acute dislocation, especially first dislocations with severe pain and joint swelling. Should be used with physical therapy and/or pendulum exercises approximately 3x/day prior to beginning a formal therapy program.

Benefits

Short-term improved pain and rest.

Harms

Potential for debility, adhesive capsulitis especially if the sling is used for a prolonged period of time, particularly if without performing range-of-motion exercises.

Frequency/Dose/Duration

Gradually wean. Pendulum exercises are generally recommended, including within the first few days after injury.

Indications for Discontinuation

Use beyond approximately 1-2 weeks, reduced acute swelling and inflammatory stage.

Rationale

There are several trials regarding external immobilization which conflict regarding efficacy, whether the trials compared external/internal immobilization or external mobilization/slings. Two trials suggest efficacy of external vs. internal immobilization (Itoi et al., 2003) (Liavaag et al., 2009). However, another trial found lack of efficacy (Finestone et al., 2009) and another reported a non-significant 38.9% reduction in dislocations with external immobilization vs. internal immobilization over 2 years with significant risk reduction among those aged 20-40 years (Murray et al., 2020). Trials conflict regarding whether external immobilization is superior to a sling, with one study suggesting efficacy (Itoi et al., 2003) while another suggested no differences (37% vs. 40% dislocations) with external immobilization vs. sling (Whelan et al., 2014). Because the quality studies conflict, there is no recommendation for a specific device or position.

There is no comparative trial with an absence of sling or immobilization, but these devices may help manage acute pain associated with shoulder dislocations and help soft tissue healing; thus, they are

recommended. An external rotation brace may be used instead of a sling to treat anterior glenohumeral dislocations as most of these have an anterior inferior labral tear. The external rotation position theoretically reduces the labrum so that it may heal in a more anatomic position (Itoi et al., 2001). Performance of pendulum exercises is usually indicated in part to prevent the potential development of adhesive capsulitis.

Slings are not recommended for shoulder instability because the condition is chronic and slings promote debility over time.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 8 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SLINGS FOR TREATMENT OF CHRONIC SHOULDER INSTABILITY

Not Recommended

Slings are not recommended for treatment of chronic shoulder instability beyond acute dislocations.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

There are no quality studies of using slings for instability. Slings may help manage acute pain associated with shoulder dislocations and help soft tissue healing. However, slings are not recommended for shoulder instability as the condition is chronic and slings promote debility and increase risk of adhesive capsulitis over time.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TAPING FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of taping for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of taping for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MAGNETS FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of magnets for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of magnets for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

11.6.5. ALLIED HEALTH INTERVENTIONS

ACUPUNCTURE FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

Not Recommended

Acupuncture is not recommended for treatment of shoulder dislocation or instability in the absence of chronic pain.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Acupuncture may be modestly effective for treatment of chronic shoulder pain (see Rotator Cuff Tendinopathies). However, most patients with a dislocation or instability do not have chronic pain. One trial of dry needling after shoulder stabilization repair found a lack of efficacy over one year (Halle, Crowell et al.). Acupuncture might be indicated for select patients with chronic pain who do not have sufficient pain control with other interventions. Thus, acupuncture is not recommended for treatment of shoulder dislocation and instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

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this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

DIATHERMY FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of diathermy for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of diathermy for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INFRARED THERAPY FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of infrared therapy for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of infrared therapy for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed,

106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ULTRASOUND FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of ultrasound for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of ultrasound for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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LASER THERAPY FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of laser therapy for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of laser therapy for treatment of shoulder dislocation or instability

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANUAL THERAPY FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of manual therapy for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of manual therapy for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANIPULATION FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of manipulation for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of manipulation for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MASSAGE FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of massage for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of massage for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

HIGH-VOLTAGE GALVANIC THERAPY FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of high-voltage galvanic therapy for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of high-voltage galvanic therapy for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

H-WAVE® DEVICE STIMULATION FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of H-wave® Device Stimulation for treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of H-wave® Device Stimulation for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

IONTOPHORESIS FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of iontophoresis for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of iontophoresis for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MICROCURRENT FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of microcurrent for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of microcurrent for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PERCUTANEOUS ELECTRICAL NERVE STIMULATION FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of percutaneous electrical nerve stimulation (PENS) for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of PENS for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed,

106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of transcutaneous electrical stimulation (TENS) for treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of TENS for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SYMPATHETIC ELECTROTHERAPY FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of sympathetic electrotherapy for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of sympathetic electrotherapy for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PULSED ELECTROMAGNETIC FREQUENCY FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of pulsed electromagnetic frequency for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of pulsed electromagnetic frequency for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INTERFERENTIAL THERAPY FOR TREATMENT OF SHOULDER DISLOCATION OR INSTABILITY

No Recommendation

There is no recommendation for or against the use of interferential therapy for the treatment of shoulder dislocation or instability.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of interferential therapy for treatment of shoulder dislocation or instability.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

11.6.6. INJECTION THERAPIES

Injections are generally not required for dislocations and are not recommended for treatment of acute dislocations. Injections are occasionally needed subsequently for concomitant rotator cuff tendinopathies or among patients who have delayed recovery for unclear reasons and in whom an empiric injection for diagnostic and therapeutic purposes is performed (see Rotator Cuff Tendinopathy Injections).

One trial of dry needling after shoulder stabilization repair found a lack of efficacy over 1 year (463).

11.6.7. SURGICAL CONSIDERATIONS

Non-operative and surgery have both been widely used for the treatment of dislocations. Surgical techniques vary depending on factors including the kind of dislocation, comitant injuries, timing after injury as well as the skills and strength of the treating provider. Recreational and occupational demands may lead one to have surgery after an initial dislocation, but for most patients the results of surgery after a recurrence should be equivalent to surgery after first dislocation. The dislocation recurrence rate has been reported at 17 to 96% (2010) (2011) (2012) (1993) (2013) (2014) (2015)

(2016) (2017) (1998) (1994) (2018) (2019) (2020) (2021) (2022) (2023) (2024) (2025), (2000) (2026) (2027) (1990) (2028) (2029) (2008) (2004) (2030) (1996) (2005) (2031).

A systematic review found an overall summary estimate of 39% (1350) and a recurrence rate of 53% among those with anterior dislocations managed by physiotherapy (1350). Another systematic review of arthroscopic Bankart repairs vs. conservative management for a first-time anterior dislocation found a recurrent instability rate of 9.7% vs. 67.4%, and a higher rate of return to play of 92.8% vs. 80.8% (2032) and another review found lower recurrence rates with operative repair at 10 years (2033). Recurrence of dislocation has been attributed to anterior labral injuries (2034) (2035) (2008) (2036) (2005) and has been used to justify attempted repairs. Younger age and male sex have been consistently associated with increased risk of recurrence of dislocation (2011) (2013) (1993) (2007) (1350), providing some rationale for greater use of surgical treatments, especially in younger patients with dislocations.

Surgical approaches to shoulder instability include arthroscopic (2037) (2038) (2039) (2040) (2041) (2042) (2043) (2044) (2045) (2022) (2046) (2047) (2048) (2049) (2050) (2051) (2052) (2053) (2054) (2055) (2056) (2057) (2058) (2059) (2060) (2061) (2062) (2063) (2064) (2065) (2066) (2067) (2068) (142) (2036) (2069) (2070) (2071) (2072) (2073) (2074) (2075) (2076) (2077) (2078) (2079) (2080) and open procedures, most frequently Bankart (capsule and labral repairs) repairs (2081) (2013) (2082) (2083) (2084) (2085) (869) (2069) (2086) (2087) (2088).

Trials comparing arthroscopic and open approaches for patients with recurrent anterior dislocations found no unequivocal evidence of superiority of one approach over the other (2089) (2090) (2091), although overall there appears to be modestly faster recovery with arthroscopic approaches over the first several postoperative months (2091). Arthroscopic capsulolabroplasty and capsulolabral augmentation have been reported for management of posteroinferior instability. (2062) (514). For posterior instability, no differences between open and arthroscopic approaches have been reported (1992), although none of the available studies are RCTs.

The outcome of surgical treatment after dislocation is highly correlated with the extent of glenoid bone loss and presence of engaging Hill-Sachs lesion (865,2092,2093). The concept of on-track and off-track lesions describes the relationship of the Hill-Sachs lesion and the glenoid. In on-track lesions, the Hills-Sachs lesion remains within the glenoid normal zone of contact in the end range of motion. In off-track lesion, the edge of the Hill-Sachs lesion translates more medially than the medial border of the glenoid normal zone of contact (2094,2095). The on-track and off-track concept has been shown to reliably predict surgical outcomes and recurrent instability (863,2096). Glenoid bone loss of greater than 20% is major risk factor for failure of arthroscopic Bankhart repair (865,2094). In case of glenoid bone loss greater than 20%, open versus arthroscopic glenoid bone grafting or coracoid sling bone grating technique (example Latarjet procedure) should be considered (2096,2097,2098). In case of off-track lesions, in addition to arthroscopic Bankhart repair, Remplissage procedure to fill in the engaging Hill-Sachs lesion and bone grafting is recommended to reduce surgical failure and risk of recurrent dislocation (2099,2093).

REDUCTION OF DISLOCATED SHOULDERS

Recommended

Relocation is recommended after dislocation. Relocation under anesthesia is recommended if an attempted relocation without anesthesia is unsuccessful.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Dislocated shoulder

Benefits

Relocate shoulder and restore function

Harms

Can fail to relocate, neurovascular injury, (further) rotator cuff injury

Frequency/Dose/Duration

None specified.

Indications for Discontinuation

Generally, after 1-2 attempts to relocate the shoulder, further attempts are best deferred until after the patient is under anesthesia

Rationale

Dislocated shoulders are best relocated as soon as possible. The longer the delay, the more likely that muscles will sufficiently contract to result in a need to perform the relocation under anesthesia. After relocation, immobilization and/or sling use is prescribed typically along with therapy. Patients have been successfully taught self-relocation (Chechik et al., 2021, Marcano-Fernández et al., 2018, Marcano-Fernández et al., 2020).

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ARTHROSCOPIC SURGERY FOR SHOULDER DISLOCATION AND INSTABILITY

Recommended

Arthroscopy or open surgery is recommended for evaluation and treatment of patients with dislocation and instability.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Shoulder dislocation or instability, including after a first traumatic dislocation. There is no requirement to have rehabilitation prior to surgery if there is a dislocation which has occurred as a consequence of an acute injury. Instability with recurrent dislocations due to congenital laxity may reasonably be rehabilitated first, prior to consideration of surgery.

Benefits

Reduced probability of dislocation and lessened symptoms of instability. Also provides an opportunity to treat other accompanying problems such as rotator cuff tear or labral tear.

Harms

Surgical complications, inadequate repair such that there are ongoing dislocations, infection, adhesive capsulitis

Rationale

Once the shoulder dislocates due to trauma, the disrupted joint capsule is lax and prone to re-dislocation. Thus, surgery after a first dislocation is reasonable, although an estimated 47% will not re-dislocate after an initial dislocation and treatment with exercise (Olds et al., 2015). There is evidence that open Bankart repair results in somewhat lower recurrence and reoperation rates than arthroscopic Bankart repairs; however the range of motion is better after arthroscopic repair (Jorgensen et al., 1999, Sperber et al., 2001, Grasso et al., 2009, Bottoni et al., 2006, Bottoni et al., 2021, Rhee et al., 2007, Archetti Netto et al., 2012, Mohtadi et al., 2014, Chen, 2015, Olds et al., 2015)

Regardless of the surgical approach used, surgery has been shown to reduce the probability of dislocation and symptoms of instability compared with non-operative management (Kirkley et al., 1999, Kirkley et al., 2005, Edmonds et al., 2003, Bottoni et al., 2002, Jakobsen et al., 2007, Yapp et al., 2020, Minkus et al., 2021, Pougès et al., 2021). One trial found that the benefit persisted and continued to grow after up to 10 years of follow-up (Yapp et al., 2020). Additional information on certain techniques has been reported: addition of electrothermal capsulorrhaphy has been found to be ineffective (McRae et al., 2016); addition of infraspinatus remplissage to arthroscopic Bankart repair for anterior shoulder instability with Hill-Sachs defects (MacDonald et al., 2021) has been found to decrease risk of recurrent instability; and arthroscopic Bankart repair with curettage of the cartilage along the anterior glenoid edge reduced dislocation recurrences (Desai et al., 2021). Bristow and Latarjet techniques were comparable in high-demand athletes (Belangero et al., 2021). Young patients typically have greater problems with recurrent dislocation and thus stronger indications for surgery after a first dislocation.

The outcome of surgical treatment after dislocation is highly correlated with the extent of glenoid bone loss and presence of engaging Hill-Sachs lesion (Wang, 2018, Flatow, 1998, Armitage, 2010). The concept of on-track and off-track lesions describes the relationship of the Hill-Sachs lesion and the glenoid. In on-track lesions, the Hills-Sachs lesion remains within the glenoid normal zone of contact in the end range of motion. In off-track lesion, the edge of the Hill-Sachs lesion translates more medially than the medial border of the glenoid normal zone of contact (Gulati, 2017, Provencher, 2012). The on-track and off-track concept has been shown to reliably predict surgical outcomes and recurrent instability (White, 2019). Glenoid bone loss of greater than 20% is major risk factor for failure of arthroscopic Bankhart repair (Wang, 2018, Provencher, 2012). In case of glenoid bone loss greater

than 20%, open versus arthroscopic glenoid bone grafting or coracoid sling bone grating technique (example Latarjet procedure) should be considered (Boileau, 2012, Cowling, 2016, Allain, 1998). In case of off-track lesions, in addition to arthroscopic Bankhart repair, Remplissage procedure to fill in the engaging Hill-Sachs lesion and bone grafting should be utilized to reduce surgical failure and risk of recurrent dislocation (Garcia, 2016, Armitage, 2010).

Arthroscopy is invasive, has adverse effects and is high cost. However, because repeat dislocations are common and instability can be significantly impairing, surgery is recommended as a treatment option.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 8 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

OPEN SURGERY FOR SHOULDER DISLOCATION AND INSTABILITY

Recommended

Open surgery or arthroscopy is recommended for evaluation and treatment of patients with dislocation and instability.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Shoulder dislocation or instability, including after a first traumatic dislocation. There is no requirement to have rehabilitation prior to surgery if there is a dislocation which has occurred as a consequence of an acute injury. Instability with recurrent dislocations due to congenital laxity may reasonably be rehabilitated first, prior to consideration of surgery.

Benefits

Reduced probability of dislocation and lessened symptoms of instability. Also provides an opportunity to treat other accompanying problems such as rotator cuff tear or labral tear.

Harms

Surgical complications, inadequate repair such that there are ongoing dislocations, infection, adhesive capsulitis

Rationale

Once the shoulder dislocates due to trauma, the disrupted joint capsule is lax and prone to re-dislocation; thus, surgery after a first dislocation is reasonable. There is evidence that open Bankart repair results in somewhat lower recurrence and reoperation rates than arthroscopic Bankart repairs; however the range of motion is better after arthroscopic repair (Jorgensen et al., 1999, Sperber et al., 2001, Grasso et al., 2009, Bottoni et al., 2006, Bottoni et al., 2021, Rhee et al., 2007, Archetti Netto et al., 2012, Mohtadi et al., 2014, Chen, 2015, Olds et al., 2015).

Surgery has been shown to reduce the probability of dislocation and symptoms of instability. Young patients typically have greater problems with recurrent dislocation and thus stronger indications for surgery after a first dislocation. Surgery is invasive, has adverse effects and is high cost. However, as repeat dislocations are common and instability can be significantly impairing, surgery is recommended as a treatment option.

A meta-analysis comparing transglenoid sutures with bioabsorbable tacks found a higher rate of recurrent dislocation (12.6 versus 3.4%); however, it largely relied on case series (Freedman et al., 2004). An experimental cadaveric study evaluated capsular plication versus anchor repair (Provencher et al., 2008). There is insufficient evidence to recommend for or against specific intraoperative techniques.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 5 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SURGERY FOR MULTIDIRECTIONAL INSTABILITY

Recommended

Inferior capsular shift procedure, capsular plication, or superior shift of redundant inferior capsule is recommended for multidirectional and posterior instability.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Recurrent, multidirectional shoulder instability or dislocation

Benefits

Reduced probability of dislocation and lessened symptoms of instability. Also provides an opportunity to treat other accompanying problems such as rotator cuff tear or labral tear.

Harms

Surgical complications, inadequate repair such that there are ongoing dislocations, infection, adhesive capsulitis

Rationale

There are no quality studies evaluating treatment of multidirectional and posterior instability and no randomized comparative trials of available operative approaches. Surgical results in case series have suggested some benefits (Neer et al., 1980, Tibone et al., 1990, Duncan et al., 1993, Pollock et al., 1993, Tibone et al., 1993, McIntyre et al., 1996, Wolf et al., 1998, Hamada et al., 1999, Treacy et al., 1999, Antoniou et al., 2000). A systematic review including non-randomized studies suggested that capsular plication and capsular shift are associated with better results (Longo et al., 2013). Currently, arthroscopic capsular placation is replacing open capsular shifts.

Surgery is invasive, has adverse effects, and is high cost. However, for some patients there is no other reasonable alternative for treatment; thus, surgery is recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ARTHROSCOPIC LAVAGE FOR SHOULDER DISLOCATIONS

No Recommendation

There is no recommendation for or against the isolated use of arthroscopic lavage for shoulder dislocations. Lavage may be a normal part of a treatment procedure, e.g., included with arthroscopy.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are three moderate-quality trials with four reports all suggesting arthroscopic lavage reduces risk of subsequent dislocation (Wintzell et al., 1999, Wintzell et al., 1999, Wintzell et al., 2000, Wintzell et al., 1996). However, there are no quality trials available evaluating a less-invasive procedure. Arthroscopic lavage as an isolated procedure is invasive, has adverse effects, is costly, is less invasive than surgical repair, but does not achieve repair of damaged tissue and there is no recommendation for or against arthroscopic lavage alone.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 22 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

11.6.8. REHABILITATION PROGRAMS

ACCELERATED REHABILITATION FOR PATIENTS AFTER ARTHROSCOPIC BANKART REPAIRS

Recommended

Accelerated rehabilitation (compared with standard rehabilitation) is recommended for select patients after arthroscopic Bankart repairs.
Strength of evidence Recommended, Evidence (C)
Level of confidence Moderate

Indications

Arthroscopic Bankart repairs for traumatic anterior instability in select, particularly younger patients

Benefits

Earlier recovery

Harms

Negligible

Frequency/Dose/Duration

Two to 3 appointments a week for 3 weeks, then twice a week for 2 weeks and once weekly to every other week for 6 to 9 additional weeks (Kim et al., 2003). Exact regimen requires individualization; however, the accelerated rehabilitation regimen has been successful and is generally recommended. Additional appointments should be based on documentation of ongoing, incremental functional gains.

Indications for Discontinuation

Recovery, reaching a plateau, noncompliance, intolerance

Rationale

There is one moderate-quality study comparing traditional with accelerated rehabilitation of patients (mean age 29) years, having undergone arthroscopic Bankart repairs for traumatic recurrent anterior instability (Kim et al., 2003). The trial documented multiple advantages of accelerated rehabilitation including greater satisfaction, lower pain scores, and faster recovery. The dislocation rate was not increased by early rehabilitation during the study period (range 27 to 45 months). Caution should be used as excessive early range of motion in first 6 weeks will over stretch repair. Accelerated rehabilitation for other post-operative patients with shoulder instability may speed return of function; however, similar cautions exist (Wintzell et al., 1999, Wintzell et al., 1999, Wintzell et al., 2000, Wintzell et al., 1996). Early rehabilitation is not invasive, appears to result in lower risks of adverse effects, is likely less costly, and thus is recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

REHABILITATION FOR POST-OPERATIVE SHOULDER INSTABILITY PATIENTS

Recommended

Rehabilitation is recommended for patients undergoing surgery for shoulder instability who do not undergo an accelerated rehabilitation program.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients undergoing surgery for shoulder instability or dislocation not addressed above.

Benefits

Recovery, regaining normal function

Harms

Negligible

Frequency/Dose/Duration

Two to 3 appointments a week for 3 weeks, then 2 a week for 2 weeks, and once a week to every other week for 6 additional weeks. Additional sets of appointments would need to be based on documentation of ongoing, incremental functional gains.

Indications for Discontinuation

Recovery, plateau in recovery, noncompliance, intolerance

Rationale

There are many different post-operative rehabilitation regimens reported in quality surgery trials and elsewhere to treat patients with shoulder instability (Kirkley et al., 1999, McDermott et al., 1999, Sperber et al., 2001, Bottoni et al., 2002, Fabbriciani et al., 2004, Kirkley et al., 2005, Jakobsen, 2007, Monteiro et al., 2008). However, there are scant quality studies reported that evaluate these different regimens to help define superior treatment programs. A phone assistance program to help encourage compliance was also reported as successful (Martinez-Rico et al., 2018). Individualization of programs based on various factors, including age, conditioning, and immediate post-surgical results, is needed (O'Brien et al., 2002, O'Brien et al., 1987). Regardless of these weaknesses, postoperative rehabilitation is recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 4 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

11.6.9. FOLLOW-UP VISITS

Generally, patients with instability require few follow-up appointments unless undergoing active treatment(s). Patients with dislocation generally require periodic appointments to follow the clinical course. Appointment frequency may be greater if workplace limitations are required and job demands are greater. Post-operative rehabilitation can be lengthy, particularly in older patients with associated injuries such as those of the rotator cuff. In those cases, therapy may be required on a prolonged basis for the patient to recover as much function as possible.

12. LABRAL TEARS, INCLUDING SUPERIOR LABRAL ANTERIOR POSTERIOR (SLAP) TEARS

12.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing labral tears from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

12.2. OVERVIEW

Labral tear management is complex. Appropriate management begins with the anatomy, pathophysiology, epidemiology, and clinical correlation of pathology with symptoms and shoulder dysfunction. Labral tears are more prevalent with advancing age; thus, in patients older than 40 years, they commonly represent a natural degenerative process in the shoulder not unlike meniscal pathology in the knee. Most SLAP tears in patients over age 40 years do not require repair (2100) (2101) (2102) (2103) (2104) (2105) (708) (2106) (1123) (2107) (2108) (2109) (2110).

Superior labral anterior posterior (SLAP) and other labral tears have been clinically recognized (1359) (2111) (2112) (2105) (2113). Labral tears can be considered in conjunction with dislocation and instability for anatomic reasons. In certain cases, SLAP tears may occur with acute traumatic dislocations (2114), but are most commonly associated with other trauma and disorders such as rotator cuff tendinopathies and acromioclavicular disorders (2100) (2101) (2102) (2104) (2105) (708) (2106) (2107) (1123) (2108) (2110).

Superior labral tears are either the result of acute traumatic injury or chronic degenerative pathology. The most common mechanism of acute injury reported is a compressive force on shoulder or a subluxation injury, such as from a fall on an outstretched arm (2112) (2102) (2115) (2105) (2107) (2116) (1123) (2117) or overhead athletic or comparable traction injuries (890). Nevertheless, overhead athletes (e.g., baseball, tennis, handball, badminton, softball, swimming, volleyball, and squash) with SLAP tears seem to not do as well after arthroscopic surgery compared to nonthrowing athletes (2118). SLAP tears in the younger, athletic throwers and overhead athletes are dissimilar from the general population and appear to require different considerations. Extrapolation of management of throwing athletes to the general population is inappropriate and has likely led to over-treatment of SLAP tears.

Labral tears occurring in older population are most commonly associated with other largely degenerative conditions and thus might have relationships to underlying degenerative conditions and not require repair (2100) (2101) (2102) (2103) (2104) (2105) (708) (2106) (2107) (1123) (2108) (2110). For the purposes of this guideline, these tears are considered distinct from the acute traumatic labral tears that can occur with dislocations. Initial patient management is generally non-operative (2109) (2119) Surgery has been utilized for patients who fail non-operative treatment and may be considered in active, younger patients (2109).

The presence of a labral tear does not in, and of itself necessitate surgery. Labral tears are often identified at surgery concurrently with other pathology such as rotator cuff tears, acromial spurring, and glenohumeral arthritis. In many of these cases, especially with advancing age, the labral tear may be irrelevant to the patient's condition and not require specific treatment. For example, if a patient's clinical evaluation is consistent with rotator cuff tear, an incidental labral tear does not need surgical repair (except perhaps in younger patients) and if it is surgically treated, there is a greater chance that the patient will have post-operative stiffness. Though there are no RCTs comparing repair of rotator cuff tears with versus without surgical repair or debridement of labral tears, literature suggests there are no advantages to repairing Type II lesions associated with rotator cuff tears in patients over age 50 (2120).

Indications for surgery for SLAP tears are not standardized and remain somewhat controversial. Expert opinion, including that of the American Academy of Orthopedic Surgeons, recommends initial conservative care management for SLAP tears. In general, conservative care management should generally last a minimum of 6 weeks. Early surgery should only be considered in cases where there is evidence of suprascapular nerve compression. The evidence for or against repairing SLAP tears over age 40 is mixed with no high- or moderate-quality studies (2121). Evidence suggests no improvement with SLAP repair at the time of rotator cuff repair and trends towards worse stiffness with simultaneous surgical repairs (2122). For many years, rotator cuff tears were repaired without ever seeing the inside of the glenohumeral joint (labral pathology was not surgically repaired), and the patients had apparently equivalent outcomes.

12.3. DIAGNOSTIC CRITERIA

There are no consensus diagnostic criteria for labral tears; the diagnosis has been described as difficult and nonspecific (2116) (2109) (2123) (887) (2124) (2125). Symptoms generally include non-radiating shoulder joint pain, increased pain with overhead activity, and painful catching or popping sensations

(2112) (2126) (895). Typical physical examination maneuvers are thought to be mostly nonspecific (2115) (2127) (2107) (2109). Other maneuvers have been developed (56) (44) (951) (41). One study suggested 100% sensitivity and 99.3% specificity of the Porcellini test for detection of posterior labral tears (2128). A comparative study found the most sensitive maneuvers to be active compression (65.2%), Hawkin's (65.2%) and Speed's (47.8%). These relatively low sensitivity values suggest that these tests will perform poorly except in high pre-test probability circumstances. This suggests clinical suspicion and confirmatory imaging or arthroscopy appear to be the best diagnostic methods (2109). The most commonly used classification system is based on the initial large case series by (2105), although additions have been made by several authors (2115) (1123) (895); however, it has been suggested to be unduly complex. The primary issues are proposed to be instability of the biceps tendon anchor or glenohumeral ligaments which then dictate operative approaches of repair of capsuloligamentous structures back to the bony glenoid rim or biceps tenodesis (2109) (see Table 7).

Table 7. Classification of Superior Labrum Anterior and Posterior (SLAP) Lesions

Type	Description
Type I	Superior labrum marked fraying with degenerative appearance. Peripheral labral edge firmly attached to glenoid and biceps tendon intact.
Type II	Fraying and degenerative changes. Superior labrum and biceps tendon stripped off glenoid. Labral-biceps anchor unstable.
Type III	Bucket-handle tear in superior labrum. Central portion of tear displaceable into joint. Peripheral portion firmly attached to glenoid and biceps tendon also intact.
Type IV	Bucket-handle tear of superior labrum as in Type III, but tear extends into biceps tendon.
Type V	Anteroinferior Bankart lesion continuing superiorly to include separation of biceps tendon
Type VI	Includes biceps separation with unstable labral flap tear
Type VII	Superior labrum-biceps tendon separation extending anteriorly beneath middle glenohumeral ligament.
Type VIII	SLAP extension along posterior glenoid labrum as far as 6 o'clock
Type IX	Pan-labral SLAP tear around glenoid circumference
Type X	Superior labral tear associated with posterior-inferior labral tear (reverse Bankart lesion)

Adapted from (2112) (2115) (895)

12.4. WORK LIMITATIONS

Patients with acute significant labral tears may be able to return to occupational activities. However, limitations are generally required to avoid symptomatic aggravation typically among those performing more physically demanding work. Limitations may include no overhead use, no lifting more than 15 pounds, no repeated forceful use, and avoidance of other activities that significantly increase symptoms. Limitations are gradually reduced as recovery progresses. If surgery is performed, there is a similar need for workplace limitations that are gradually reduced.

12.5. DIAGNOSTIC RECOMMENDATIONS

12.5.1. X-RAYS

X-rays show bony structures and are the initial tests for the evaluation of most cases of shoulder pain (126) (127).

X-RAYS FOR LABRAL TEARS

Recommended

X-rays are recommended for evaluation of acute, subacute, or chronic shoulder pain thought to be related to labral tear(s).
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Most patients with shoulder pain are candidates for x-rays, especially for significant trauma, pain without trending towards improvement, impaired use, and those with red flags. Reportedly, x-ray has been helpful for diagnosing os acromiale in shoulder pain patients who were otherwise thought to not have the condition (Burbank et al., 2008).

Benefits

Diagnosis of a fracture, calcific tendinitis, or otherwise latent medical condition(s).

Harms

Medicalization or worsening of otherwise benign shoulder condition; minor radiation exposure.

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient with two to three views. For patients with chronic shoulder pain, it may be reasonable to obtain a second set of x-rays later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

X-rays are helpful to evaluate most patients with shoulder pain, both to diagnose and to assist with the differential diagnostic possibilities such as tendinoses and arthroses which may accompany labral tears. X-rays are particularly helpful for diagnosis of calcific tendinitis, which results in different treatment options. They may also help to suggest soft tissue pathology, including large chronic rotator cuff tears.

Because x-ray has been performed for more than 120 years as a diagnostic procedure, it is unsurprising that there is little quality evidence to support its use. The threshold for also ordering x-rays of the cervical spine and/or elbow joint should be low, particularly if the findings on shoulder x-ray are either normal or do not readily explain the degree of abnormality. Patients with shoulder pain might show greater tuberosity osteopenia, cystic degenerative changes, and spurring, thought to be a marker of chronicity of rotator cuff tears. Glenohumeral arthrosis is also more likely if there is a full-thickness

rotator cuff tear (Gartsman et al., 1997). Plain radiographic findings are used to stage disease involvement in osteonecrosis or humeral avascular necrosis. Early x-rays are usually normal or have less distinct trabecular patterns since the living part of the bone does not image (Ficat, 1985, Harreld et al., 2009). As the disease progresses, x-rays begin to show osteoporotic areas, progressing to sclerotic areas and finally flattening and bony collapse (Ficat, 1985, Harreld et al., 2009).

X-rays are non-invasive, low to moderately costly, have little risk of adverse effects, and therefore are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

12.5.2. SHOULDER ARTHROSCOPY

Arthroscopy has been used for diagnosis and as part of a therapeutic surgical treatment (143) (58) (144) (145) (142) (141).

See Surgical Considerations for more information.

12.5.3. COMPUTED TOMOGRAPHY

Computerized tomography remains an important imaging procedure, particularly for bony anatomy, whereas MRI is superior for soft tissue abnormalities. However, most patients have issues with soft tissue rather than bony abnormalities in the shoulder, thus on a population basis, far fewer CT scans are ordered. CT may nevertheless be useful for shoulder joint abnormalities where advanced imaging of the bones is required (i.e., complex proximal humerus fracture, scapular fracture). CT also may be useful to evaluate the anatomy in patients with contraindications for MRI (most typically an implanted metallic-ferrous device). CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – glenoid deficiency and humeral Hill-Sachs – as MRI is not as good for bone imaging. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear.

COMPUTED TOMOGRAPHY FOR LABRAL TEARS

Not Recommended

Computed tomography (CT) is not recommended for the evaluation of labral tears.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

CT without arthrography is not indicated for evaluating labral tears, as arthrography is needed and MRI is superior.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

CT ARTHROGRAPHY FOR LABRAL TEARS

Sometimes Recommended

Computed tomography (CT) arthrography is recommended for the select evaluation of labral tears.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Imaging for labral tears in which there are contraindications for MR Arthrography (e.g., ferrous implant). CT may be preferable if there also are concerns about complex proximal humeral and glenoid/scapular fractures or other calcified structures. For most shoulder conditions, MRI and MRA are superior for imaging soft tissues.

Benefits

Diagnosis and understanding of the degree of labral tearsn, as well as osseous abnormalities such as complex fractures

Harms

Radiation exposure, pain of the procedure, infection

Frequency/Dose/Duration

Obtaining a CT arthrogram once is generally sufficient. For patients with chronic shoulder pain, it may be reasonable to obtain a second CT later if symptoms substantially change.

Rationale

MR arthrography is considered superior to CT arthrography for imaging most labral tears, as well as advanced imaging of soft tissues. However, where imaging calcified structures is required, CT is considered superior. This includes complex proximal humeral and glenoid/scapular fractures. CT arthrography is minimally invasive, has few, if any, adverse effects but is costly. It is recommended for select use.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 0 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

12.5.4. MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for many shoulder joint problems since it tends to be helpful for imaging soft tissues, particularly the rotator cuff (596) (598) (599) (594) (593) (600) (184) (854) (601) (597) (57) (595) (591).

MAGNETIC RESONANCE IMAGING FOR LABRAL TEARS

Recommended

MRI without arthrography is selectively recommended for evaluation of some labral tears. There are select indications for evaluating bony Bankart lesions or Hill-Sachs lesions. MRI with angiography is preferrable for the evaluation of other potential labral tears.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients with subacute or chronic shoulder pain with symptoms, or clinical suspicion, of labral tears. MRI may be reasonably successful in identifying tears compared with MRI plus angiography when there is joint swelling, thus especially when there is accompanying acute traumatic injury. Patients should generally have failed non-operative treatment including NSAID and waiting 4 to 6 weeks without trending towards resolution. Among patients lacking acute trauma (e.g., onset of mechanical joint symptoms without an accompanying sports-like event such as acute dislocation or fall producing glenohumeral joint bleeding), MRI with angiography is generally preferable.

Benefits

Secure a diagnosis.

Harms

False positives and false negatives for labral tears.

Frequency/Dose/Duration

A second study is rarely needed, and should be based on significant changes in symptoms and examination. If a second study is felt to be needed, there is generally a need for accompanying arthrography.

Rationale

A high-quality study of indirect MRA found 95-97% sensitivity for labral tears compared with 79-83% for MRI, while accuracy with MRA was 93-95% compared with 84-86% for MRI (Fallahi, 2013). A study comparing MRI, MRA and US found MRA superior for evaluating labral, capsular ligamentous complex lesions while MRI was more accurate for bony Bankart lesions or Hill-Sachs lesions (Pavic et al., 2013). A comparative study found 95-97% sensitivity of indirect MRA, which does not require articular injection, compared with 79-83% sensitivity for MRI (Fallahi, 2013). One study found that adding MRA to MRI added little if the MRI already demonstrated findings (Magee, 2015).
MRI without arthrography is selectively recommended not indicated for evaluating labral tears, especially among patients with joint swelling and/or when there is accompanying acute traumatic injury (e.g., among patients lacking acute trauma such as onset of mechanical joint symptoms without an accompanying sports-like event such as acute dislocation or fall producing glenohumeral joint bleeding). MRI with angiography is generally preferable among patients having mechanical joint symptoms but without joint swelling as MR arthrography has been consistently shown to be superior in multiple quality studies. MRI may also be helpful for select use of evaluating bony Bankart lesions or Hill-Sachs lesions.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Of the 21 articles considered for inclusion, 5 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

12.5.5. MAGNETIC RESONANCE ARTHROGRAM

Magnetic resonance arthrography (MRA) combines an MRI with an arthrogram to overcome MRI limitations and is usually performed in preference to CT arthrography unless bony structure definition is needed as well (173) (174). MR arthrography is particularly thought to be effective for imaging labral pathology (180) (179) (177) (175) (43) (181) (176) (178). MRA is thought to be effective for imaging superior labral anterior posterior (SLAP) or other labral tears (885) (886) (180) (179) (177) (175) (43) (887) (176) (178). MR arthrography combines MRI with an arthrogram to identify both findings available with MRI, as well as the better capability to define labral tears among patients with symptoms of labral injuries in the shoulder (181).

MR ARTHROGRAM FOR LABRAL TEARS

Recommended

MR arthrography is recommended for diagnosing labral tears in patients with subacute or chronic shoulder pain.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Patients with subacute or chronic shoulder pain with symptoms (or clinical suspicion) of labral tears. Patients should generally have failed non-operative treatment including NSAID and waiting 4 to 6 weeks without trending towards resolution.

Benefits

Secure a diagnosis.

Harms

False positives and false negatives for labral tears Arthrography improves the accuracy especially regarding complete rotator cuff tears and significant labral tears. Small risk of infection and complications from the injection.

Frequency/Dose/Duration

A second study is rarely needed, and should be based on significant changes in symptoms and examination.

Rationale

A high-quality study of indirect MRA found 95-97% sensitivity for labral tears compared with 79-83% for MRI (Fallahi, 2013). A moderate-quality study found MRA had 93% sensitivity, 96% specificity, and 94% accuracy compared with arthroscopy (Saba et al., 2017). A study comparing MRI, MRA, and US found MRA to be superior for evaluating labral, capsular ligamentous complex lesions, while MRI was more accurate for bony Bankart lesions or Hill-Sachs lesions (Pavic et al., 2013). Another study found that MRA was 60% sensitive for anterior labral tears, 75% for SLAP tears, 57% for posterior tears, 87% for any labral tear, and 91% for Hill-Sachs lesions compared with arthroscopy (Saqib et al., 2017). A comparative study found 95-97% sensitivity of indirect MRA, which does not require articular injection, compared with 79-83% sensitivity for MRI (Fallahi, 2013).

One comparative study found a combination of MRA and unenhanced MRI as superior to MRA alone (Magee, 2015), and that adding MRA to MRI added little if the MRI already demonstrated findings (Magee, 2016). A comparison of high- versus low-field MR imaging for SLAP tears among symptomatic patients found high field superior for diagnosing SLAP tears (Tung et al., 2000). The sensitivity of high field MRA was 90% and specificity 63%, while sensitivity for low field was 64% and 70% specificity. MRA was found superior to CT arthrography (CTA) and marginally better than MRI for identification of labral tears in a case series of patients with recurrent anterior instability, prior anterior dislocation or shoulder pain of unknown cause (Chandnani et al., 1993). MRA sensitivity for a labral tear was 96.4%, MRI was 92.9%, and CTA was 73.1%. Specificity was 100% for all three tests; however, this appears overstated as there were only two patients without a tear in this small case series.

MR arthrography is invasive, has adverse effects (including a low, but definite, risk of infection), and is painful. It is also costly, although MRA has been shown to provide better cost effectiveness than MRI or CT arthrography for select diagnoses (Oh et al., 1999). Consistent studies have shown MRA is the best imaging procedure available for patients thought to have labral tears or patients with good strength in order to assess the labrum and rotator cuff with traumatic injury simultaneously, and is thus recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Of the 21 articles considered for inclusion, 6 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

12.5.6. ULTRASOUND

Diagnostic ultrasound has been used for evaluating labral tears.

ULTRASOUND FOR LABRAL TEARS

Not Recommended

Ultrasound is not recommended for evaluation of labral tears.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Low

Rationale

A study comparing MRI, MRA, and ultrasound (US) found MRA superior for evaluating labral, capsular ligamentous complex lesions, while MRI was more accurate for bony Bankart lesions or Hill-Sachs lesions (Pavic et al., 2013). A study assessing US for evaluation of posterior labrocapsular structures suggested US may have limited indications when there are contraindications for MRA (Ogul et al., 2020). A trial evaluating US after injection of gadolinium for an MRA reported the injection helped detection of labral tears (Jeong, 2012). Ultrasound has been compared with MR arthrography and is inferior in quality studies. Thus, ultrasound is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Of the 21 articles considered for inclusion, 3 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

12.5.7. SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY FOR LABRAL TEARS

Not Recommended

Single-proton emission computed tomography (SPECT) is not recommended for the evaluation of patients with suspected labral tears.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain with suspected labral tears, and they are not believed to provide significant additional information above more standard imaging techniques. Thus, they are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

12.5.8. POSITRON EMISSION TOMOGRAPHY (PET)

POSITRON EMISSION TOMOGRAPHY FOR LABRAL TEARS

Not Recommended

Positron emission tomography (PET) is not recommended for the evaluation of patients with suspected labral tears.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain with suspected labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If

relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

12.5.9. DIAGNOSTIC INJECTIONS

Diagnostic injections particularly of the subacromial space, glenohumeral joint and acromioclavicular joint are sometimes performed. However, they are nearly always performed in combination with a therapeutic intervention, such as a glucocorticosteroid injection. Injection with a therapeutic agent is nearly always preferable due to less overall invasiveness with 1 injection rather than 2, as well as the potential to assess the patient both immediately post-injection for diagnostic purposes as well as longer term for therapeutic purposes (see Injection Therapies).

12.6. TREATMENT RECOMMENDATIONS

12.6.1. INITIAL CARE

Initial care of a labral tear involves identification of other accompanying disorders, such as rotator cuff tendinopathies, tears, and acromioclavicular joint issues, and treated accordingly (888). Over-the-counter (OTC) analgesics and self-applications of heat and ice have been used to treat labral tears. Slings are generally not required, although they might be reasonable for brief treatment of severe symptomatic tears, with use gradually weaned.

SELF-APPLICATION OF HEAT OR ICE FOR TREATMENT OF LABRAL TEARS

Recommended

Self-application of heat or ice is recommended for treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Shoulder injuries with suspected labral tears (or other trauma or injuries).

Benefits

Self-management of the pain

Harms

Negligible

Frequency/Dose/Duration

Ice and heat are typically used 3-5 times a day

Indications for Discontinuation

Resolution of pain, lack of efficacy, intolerance, complication

Rationale

There are no quality trials evaluating analgesics, ice or heat for managing labral tears. Self-applications of heat and ice may be helpful for self-management of symptoms, are not invasive, have low adverse effects, not costly, and are believed to be helpful for treating symptoms; thus, they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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SLINGS FOR TREATMENT OF LABRAL TEARS

Not Recommended

Slings are not recommended for treatment of labral tears other than in the setting of significant trauma.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There are no quality trials evaluating slings for management of acute SLAP and other labral tears. Slings are generally not needed for labral tears, and have risks of debility and adhesive capsulitis. They may be reasonable for significant trauma or severe symptomatic tears, but are not normally indicated for isolated labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

12.6.2. MEDICATIONS

Over-the-counter medications may be helpful for pain associated with labral tears. Generally, the only medications commonly used for labral tears are NSAIDs (889) (890) (891) (892). Prescription medications such as opioids (see Medications for Rotator Cuff Tendinopathy) for pain management require judicious use and should only be considered in select, severe cases. Patients may also require medications post-operatively.

There is no quality literature specific to shoulder labral tears for nearly all of the following interventions. In the absence of quality evidence, it is recommended that labral tears be managed according to the recommendations for Rotator Cuff Tendinopathy and Shoulder Pain:

- NSAIDs for Treatment of Rotator Cuff Tendinopathies and Shoulder Pain *[Strongly Recommended, Evidence (A)]*
- Acetaminophen for Acute, Subacute, Chronic, or Post-operative Shoulder Pain *[Recommended, Insufficient Evidence (I)]*
- Norepinephrine Reuptake Inhibiting Anti-depressants for Subacute or Chronic Shoulder Girdle Pain *[Recommended, Insufficient Evidence (I)]*
- Selective Serotonin Reuptake Inhibitors for Acute, Subacute, or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Anti-convulsants for Acute, Subacute or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Capsicum Creams for Acute, Subacute, Chronic Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*
- Topical NSAIDs, including Diclofenac Epolamine for Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*
- Topical Glyceryl Trinitrate, Lidocaine Patches, Eutectic Mixture of Local Anesthetics (EMLA), and Other Creams/Ointments for Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*

See also the ACOEM Opioids guideline for the treatment of subacute and chronic pain.

12.6.3. ALLIED HEALTH INTERVENTIONS

Self-applications of heat or cryotherapies may be helpful for symptom modulation and are recommended to treat labral tears. Therapy including education and exercise is also recommended. Acupuncture and other physical methods such as massage, diathermy, and magnets have been used to treat shoulder pain that includes labral tears.

ACUPUNCTURE FOR CHRONIC PAIN FROM LABRAL TEARS

Sometimes Recommended

Acupuncture is selectively recommended to control chronic pain associated with labral tears.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Highly selected patients with chronic shoulder pain of 3+ months who have inadequate relief and incapacity after multiple interventions including NSAIDs, a quality active exercise program with which there has been compliance, and potentially surgical repair. Caution that use may augment reliance on passive modalities instead of active, self-care treatment strategies.

Benefits

Modest reduction in pain.

Harms

Rare needling of deep tissue, such as artery, lung, etc. and resultant complications. Use of acupuncture may theoretically increase reliance on passive modality(ies) for chronic pain.

Frequency/Dose/Duration

Frequency and duration pattern in the quality trial was weekly for 8 weeks for other shoulder disorders. An initial trial of 4 appointments would appear reasonable in combination with a conditioning program of aerobic and strengthening exercises. An additional 4 appointments should be tied to improvements in objective measures after the first 4 treatments, for a total of 8 (de Hoyos et al., 2004). If acupuncture is trialed in a patient, objective functional improvement should be demonstrated after 4 visits.

Indications for Discontinuation

Resolution, intolerance, non-compliance including non-compliance with aerobic and strengthening exercises, no functional gains demonstrated.

Rationale

The overall body of evidence for the use of acupuncture is relatively weak, and quite limited for labral tears. The more general shoulder literature suggests some potential efficacy (see Rotator Cuff Tendinopathy); thus, by inference, acupuncture is also recommended for chronic shoulder pain related to labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

DIATHERMY FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of diathermy for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of diathermy for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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INFRARED THERAPY FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of infrared therapy for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of infrared therapy for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized,

randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ULTRASOUND FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of ultrasound for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of ultrasound for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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LASER THERAPY FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of laser therapy for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of laser therapy for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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MANUAL THERAPY OR MOBILIZATION FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of manual therapy or mobilization for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of manual therapy or mobilization for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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MANIPULATION FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of manipulation for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of manipulation for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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MASSAGE FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of massage for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of massage for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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HIGH-VOLTAGE GALVANIC THERAPY FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of high-voltage galvanic therapy for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of high-voltage galvanic therapy for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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H-WAVE® DEVICE STIMULATION FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of H-wave® Device Stimulation for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of H-wave® Device Stimulation for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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IONTOPHORESIS FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of iontophoresis for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of iontophoresis for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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MICROCURRENT STIMULATION FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of microcurrent stimulation for the treatment of superior labral anterior posterior (SLAP) or other labral tears.

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of microcurrent stimulation for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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SYMPATHETIC ELECTROTHERAPY FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of sympathetic electrotherapy for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of sympathetic electrotherapy for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PERCUTANEOUS ELECTRICAL NERVE STIMULATION (PENS) FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of percutaneous electrical nerve stimulation (PENS) for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of percutaneous electrical nerve stimulation (PENS) for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) FOR TREATMENT OF LABRAL TEARS

No Recommendation

There is no recommendation for or against the use of transcutaneous electrical nerve stimulation (TENS) for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of TENS for treatment of shoulder labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TAPING FOR TREATMENT OF LABRAL TEARS

Not Recommended

Taping, magnets, pulsed electromagnetic frequency, and interferential therapy are not recommended for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy and there is evidence suggesting inefficacy for other shoulder disorders, and thus taping is not recommended for treatment of labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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MAGNETS FOR TREATMENT OF LABRAL TEARS

Not Recommended

Magnets are not recommended for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy and there is evidence suggesting inefficacy for other shoulder disorders, and thus magnets are not recommended for treatment of labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PULSED ELECTROMAGNETIC FREQUENCY FOR TREATMENT OF LABRAL TEARS

Not Recommended

Pulsed electromagnetic frequency are not recommended for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy and there is evidence suggesting inefficacy for other shoulder disorders, and thus pulsed electromagnetic frequency is not recommended for treatment of labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INTERFERENTIAL THERAPY FOR TREATMENT OF LABRAL TEARS

Not Recommended

Interferential therapy is not recommended for the treatment of superior labral anterior posterior (SLAP) or other labral tears.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy and there is evidence suggesting inefficacy for other shoulder disorders, and thus interferential therapy is not recommended for treatment of labral tears.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

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12.6.4. INJECTION THERAPIES

Injections are generally not indicated for labral and SLAP tears. However, they are sometimes utilized to treat patients who have other conditions, such as rotator cuff tendinopathies, or as an injection for combined diagnostic and therapeutic purposes. An injection may also be selectively indicated for patients who have delayed recovery for unclear reasons (see Rotator Cuff Tendinopathy Injections).

INJECTIONS FOR TREATMENT OF LABRAL TEARS

Sometimes Recommended

Injections are selectively recommended for the combined diagnosis and treatment of labral tears. Subacromial glucocorticosteroid injections may also be selectively indicated for patients who have delayed recovery for unclear reasons (see Rotator Cuff Tendinopathy Injections). However, injections are generally not indicated for labral and SLAP tears.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

See Rotator Cuff Tendinopathies for more information.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

12.6.5. SURGICAL CONSIDERATIONS

Nonoperative treatment has been widely used for labral tears. Surgical repair will not improve the clinical outcome if the labral tear is not the cause of the problem. When the tear is the cause of the problem, then repair is usually the treatment of choice if the patient does not improve with non-operative management. The rate of success is unclear as there are no large population-based studies available, although some believe that patients who engage in throwing motions have a worse prognosis (891). A considerable proportion of these cases do not resolve with non-operative treatment. Arthroscopic (2129) (894) (2130) (2131) (2132) (2133) (2134) (2113) (896) (2135) (2136) (892) (898) and some open techniques (2137) or combined approaches (2113) have been utilized for treatment. Some include addressing other abnormalities such as ganglion cysts along with the surgical approach (2130). Surgical approaches involving debridement alone or removal of the SLAP/labral lesion have been mostly abandoned due to low success rates and high rates of subsequent impairment and disability (2100) (2101). Subsequent attempts at repair of the tears (SLAP/labral lesion) have reported better results in case series than non repair approaches (2138) (2139) (2106) (2140) (36) (890) (2131). The risk for poor outcomes after surgery and rehabilitation has been estimated at 32% (2141) and are thought to be worse in workers' compensation patients (2142).

The following text is provided as introductory review of surgical options, with the determination of the procedure and approach depended on surgeon preferences for the patient's presentation. The type of tear is believed to guide the most appropriate surgical treatment (2143) (2125)(2109), although there is not complete agreement on the approaches. For Snyder type I SLAP tears, debridement is most recommended (889) (2109) (887) (896), although some have recommended no debridement as the fraying is believed to be normal (2126). There are several different Snyder type II SLAP lesions that, along with other types of unstable tears, have been recommended for repair with sutures or tacks (2112) (2138) (2144) (2139) (2102) (2104) (2145) (2105) (1123) (889) (2109) (887) (2133) (896) (439). Biceps tenodesis has also been reportedly successful for treatment of some but not all Snyder Type II lesions, particularly in patients over 40 years old in whom repairing SLAP tears is associated with increased post-operative stiffness (2144) (2101) (2146).

Snyder Type III lesions have been recommended for treatment with debridement involving the bucket handle tear and attempted repair with larger labral tears (2109) (887) (896). Snyder Type IV lesions

have been recommended for biceps debridement if there is less than 40% involvement and either repaired or tenodesed if greater than 30 to 50% involved (2116) (2129) (887) (2147). Specific labral pathologies are associated with shoulder injury and dysfunction. Some of these patients will need surgery to treat instability which will involve labral repair. Labral debridement in these cases does not treat the instability. Some chronic degenerative SLAP tears that can be correlated with the patient's symptoms may require repair for management.

ARTHROSCOPIC AND/OR OPEN SURGERY FOR LABRAL TEARS

Sometimes Recommended

Arthroscopic or open surgery is selectively recommended for select treatment of labral or superior labral anterior posterior (SLAP) tears, especially Type III and Type IV.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Symptoms with MRA or MRI findings and clinical suspicion of labral or SLAP tear that do not symptomatically resolve after a minimum of approximately 6 weeks of non-operative treatment. MRA findings should generally be larger tears (e.g., Snyder Type III or IV). Most individuals over age 40 do not appear to require surgical repair, although a minority who fail to either resolve or trend towards resolution may need operative repair (Altchek et al., 1992) (Cordasco et al., 1993) (Resch et al., 1993) (Payne, 1994) (Warner et al., 1994) (Snyder et al., 1995) (Berg et al., 1998) (Segmuller et al., 1997) (Handelberg et al., 1998) (Morgan et al., 1998) (Pearce et al., 2000) (Parentis et al., 2002) (Kim et al., 2003).

Benefits

Improvement in symptoms, especially with large tears

Harms

Stiffness, reduced function, operative complications, adhesive capsulitis

Rationale

There is one high-quality RCT showing that surgical repair of type II tears is not superior to sham surgery (Schrøder et al., 2017), and there are no sick leave or return-to-work benefits (Brox et al., 2020). There are no quality studies of larger, type III and IV tears. There are no quality trials comparing non-operative with operative management of labral and SLAP tears. The current low-quality evidence suggests results with surgical repair are superior to non-operative management for larger tears. There is one quality trial among patients with SLAP and rotator cuff tears that reported biceps tenotomy plus rotator cuff tear was superior to repair of the SLAP (Franceschi et al., 2008); however, this trial is unable to address the central issue of appropriateness of surgery and surgical indications. Thus, while surgery is invasive, has adverse effects, and is high cost, surgical repair is selectively recommended for patients whose larger labral tears are likely the cause of the clinical picture and do not resolve or trend towards resolution over a minimum of 6-12 weeks.

The evidence for or against repairing larger SLAP tears over age 40 is mixed with no high- or moderate-quality studies (Provencher et al., 2019). Evidence suggests no improvement with SLAP repair at the

time of rotator cuff repair and trends towards worse stiffness with simultaneous surgical repairs (Alpert et al., 2010). For many years, rotator cuff tears were repaired without ever seeing the inside of the glenohumeral joint (labral pathology was not surgically repaired). The patients had equivalent outcomes to current reports.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Of the 21 articles considered for inclusion, 7 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

12.6.6. POSTOPERATIVE REHABILITATION

Many different rehabilitation protocols have been reported that address rehabilitation for labral and SLAP tears (893) (894) (895) (36) (896) (891) (897). There is no single protocol that is deemed most appropriate for all labral and SLAP tears. Individualization of programs based on various factors, including age, conditioning, and immediate post-surgical results is needed.

One protocol involved immobilizer use for 3 weeks with passive forward elevation and full elbow ROM. During weeks 4 to 6, ROM is increased up to 90 degrees of abduction and flexion. After 6 weeks, full ROM is begun; with gradual strengthening, biceps contraction begins. Overhead activities and strenuous biceps activity are avoided for 12 weeks. At 12 to 16 weeks, physical therapy is discontinued and normal activities resumed. Throwing does not resume for 4 to 5 months with full return to overhead sports at 8 to 9 months (895).

Another protocol used an immobilizer for 4 weeks with active/active-assisted to 40 degrees of external rotation; 140 degrees of forward flexion and exercises of wrist, hand, and elbow ROM; grip strengthening; isometric abduction; and internal/external rotation at side. Weeks 4 to 6 used increased ROM to full and exercises of wrist/hand ROM, grip strengthening, Theraband for isometrics, prone extensions, and scapular stabilizing. In weeks 6 to 12, patients progressed to full active ROM and exercises, advanced to weights, and began upper-body ergometer. Weeks 12 to 6 months included full active motion without discomfort and exercises of progression to work/sport, return to weight room at 3 months and return to contact sports at 6 months (896). However, another protocol utilized an immobilizer for 7 to 10 days followed by gentle pendulum exercises and passive ROM and isometric strengthening. Active-assisted exercises were added at 4 weeks with a goal of full ROM at 6 to 8 weeks. Rotator cuff and periscapular strengthening with Theraband was added at 6 weeks and progressive strengthening at 16 weeks with a goal for return to usual activities at 4 to 6 months (898). Individualization of programs based on various factors, including age, conditioning, and immediate post-surgical results is needed.

REHABILITATION FOR PATIENTS AFTER ARTHROSCOPIC OR OPEN LABRAL TEAR REPAIRS

Recommended

Rehabilitation is recommended for patients after arthroscopic or open labral and superior labral anterior posterior (SLAP) tear repairs.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Arthroscopic or open repairs of labral and SLAP tears.

Benefits

Improved recovery and function

Frequency/Dose/Duration

Two to 3 appointments per week for 3 weeks, then 2 per week for 2 weeks and once weekly to every other week for 6 to 9 additional weeks (Kim et al., 2003). Exact regimen requires individualization; however, regimens are provided for guidance as examples of published protocols and are recommended. Results of the exercise prescription should be regularly monitored and failure to progressively improve is an indication to either revisit the differential diagnosis and/or seek a second opinion/consultation, particularly by the time approximately 6-12 therapy appointments is reached

Indications for Discontinuation

Recovery, plateau in recovery, noncompliance, or intolerance

Rationale

One moderate-quality RCT found no differences between a 12-month home based exercise program and usual care (Multanen et al., 2020). There are no quality trials that address rehabilitation for labral and SLAP tears. However, exercise appears necessary and education with a home-exercise program appears to be required for nearly all patients. Rehabilitation is not invasive, has low adverse effects, but is moderate to high cost; however, it seems necessary and is thus recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder labral tear, SLAP; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,039 articles in PubMed, 13,800 in Google Scholar, and 2 from other sources†. We considered for inclusion 4 from PubMed, 15 from Google Scholar, and 2 from other sources. Of the 21 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If

relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

12.6.7. FOLLOW-UP VISITS

Most patients with labral tears generally require a few follow-up appointments for purposes of monitoring symptoms, advancing treatment, and gradually reducing limitations if the tear is gradually resolving with non-operative care. Patients with slower resolution, need of operative care, or with other accompanying disorders will require a considerably greater number of appointments. Frequencies of appointments may also be greater if workplace limitations are required and job demands are higher. Post-operative rehabilitation can be extensive, particularly in older patients with other associated injuries such as rotator cuff injuries. In those cases, there may be a requirement for therapy on a prolonged basis to recover as much function as possible, until the achievement of objective evidence of a plateau.

13. ACROMIOCLAVICULAR SPRAINS AND DISLOCATIONS

13.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing acromioclavicular sprains and dislocations from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

13.2. OVERVIEW

Acromioclavicular (AC) sprains and dislocations are common injuries, especially in contact sports (899,900), but they can also occur in settings of automobile crashes, falls, and accidents (901,902). Thus, they are occasionally work-related conditions. Long-term risks include secondary rotator cuff tendinopathies, acromioclavicular instability, and osteoarthrosis in 50% (903).

13.3. DIAGNOSTIC CRITERIA

The most commonly used scale grades AC sprains and dislocations from I to VI (904,905,906). Grades I and II are managed non-operatively. Grade III includes severe dislocation of the AC joint with

elevation of the distal clavicle of at least 1 clavicular diameter on AP radiograph. Grades IV to VI are believed to require surgery (901,907,902).

Table 8. Acromioclavicular Joint Disruptions with Pathophysiology and Basic Treatment*

Grade	
I	Mild disruption of AC joint ligaments
	Non-operative
II	Moderate force and disruption of AC ligaments and sprained coracoclavicular ligaments
	Non-operative
III	Severe force with disruption of AC and CC ligaments. Joint dislocation usually present.
	Mostly non-operative. Sometimes operative, especially if heavy physical demands on shoulder
IV	Severe force usually with disruption of AC and CC ligaments.
	Posterior clavicle displacement present
	Operative
V	Severe force with marked superior displacement of lateral clavicle.
	Disrupted AC and CC ligaments as well as deltoid and trapezius attachment to clavicle.
	Operative
VI	Severe force with lateral clavicle displacement under the coracoid.
	Operative

*Adapted from (904,905,906,908).

13.4. DIAGNOSTIC RECOMMENDATIONS

13.4.1. X-RAYS

X-rays are the initial test for evaluation of most cases of AC shoulder pain (127,126).

X-RAYS FOR ACROMIOCLAVICULAR JOINTS

Recommended

X-rays are recommended for evaluation of the AC joint.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Most patients with shoulder trauma. Also for those with bony pain, abnormalities on exam and/or those not responding to treatment as expected.

Benefits

Diagnosis of a fracture, calcific tendinitis, or otherwise latent medical condition(s).

Harms

Medicalization or worsening of otherwise benign shoulder condition; minor radiation exposure.

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient. For patients with chronic AC/shoulder pain, it may be reasonable to obtain a second set of x-rays later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

X-rays are helpful to evaluate most patients with shoulder pain, especially to assess fractures in the setting of trauma. X-rays are helpful to also identify other bony abnormalities and thus are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.4.2. BONE SCANS

Bone scans involve intravenous administration of Technetium Tc-99m, a radioactive tracer medication that is preferentially concentrated in areas of metabolic activity (turnover) in bone. The radioactivity is then detected by a large sensor and converted into skeletal images showing areas of increased uptake. There are many causes for abnormal radioactive uptake, thus positive bone scans are not highly specific. Bone scans have been used for diagnosis of early osteonecrosis prior to findings on x-ray, among other uses. Bone scans are generally not needed for AC joint problems unless there are other conditions and/or symptoms present, such as osteonecrosis, symptoms elsewhere, and/or systemic disorders.

13.4.3. COMPUTED TOMOGRAPHY

Computed tomography (CT) remains an important imaging procedure, particularly for bony anatomy, whereas magnetic resonance imaging (MRI) is superior for soft tissue abnormalities. However, most

patients have issues with soft tissue rather than bony abnormalities in the shoulder, thus on a population-basis, far fewer CT scans are ordered. CT may nevertheless be useful for shoulder joint abnormalities where advanced imaging of the bones is required (i.e., acromioclavicular fractures, complex proximal humerus fracture, scapular fracture). CT also may be useful to evaluate the anatomy in patients with contraindications for MRI (most typically an implanted metallic-ferrous device). CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – glenoid deficiency and humeral Hill-Sachs – as MRI is not as good for bone imaging. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear.

COMPUTED TOMOGRAPHY FOR EVALUATION OF ACROMIOCLAVICULAR JOINT

Sometimes Recommended

Computed tomography is selectively recommended for evaluation of complex or unusual fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Imaging for complex or unusual AC joint fractures and/or proximal humeral and glenoid/scapular fractures or other calcified structures. For most shoulder conditions, particularly for concerns about the rotator cuff, MRI is superior. CT is also indicated where advanced imaging is indicated but there is a contraindication for MRI (e.g., ferrous/metal implant). CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – glenoid deficiency and humeral Hill-Sachs – as MRI is not as good for bone imaging.

Benefits

Diagnosis and understanding of the degree of complex fractures, calcific tendinitis.

Harms

Radiation exposure.

Frequency/Dose/Duration

Obtaining a CT once is generally sufficient. For patients with chronic shoulder pain, it may be reasonable to obtain a second CT later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

X-rays generally suffice for the vast majority of AC trauma. However, where there are complex or unusual AC joint fractures and/or proximal humeral and glenoid/scapular fractures or other calcified structure concerns, CT is recommended. MRI is considered superior to CT for imaging most shoulder abnormalities where advanced imaging of soft tissues is usually the primary concern, especially regarding rotator cuff tendinopathies. CT is minimally invasive, has few, if any, adverse effects but is costly. It is recommended for select use.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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13.4.4. CT ARTHROGRAPHY

Arthrography involves the injection of contrast into the joint. It was modified in the 1970s to include injection of air ("double contrast") (131). Arthrography under fluoroscopy in isolation has now been almost entirely replaced by other procedures, including MRI and MR arthrography, primarily due to its low sensitivity for full-thickness tears and essentially no sensitivity for partial thickness tears (875). Most arthrograms, including MR arthrogram and CT arthrogram, are performed using fluoroscopy to localize the joint and inject the contrast agent.

CT arthrography is considered preferable to MR arthrography when bony structure definition is needed as well (173,174). MR arthrography is more effective for imaging labral pathology, but does not image the AC joint as well as CT (180,179,177,175,43,181,176,178).

CT ARTHROGRAM FOR EVALUATING THE ACROMIOCLAVICULAR JOINT WHILE ALSO DIAGNOSING LABRAL TEARS

Recommended

CT arthrography is recommended for concerns about AC joint injury with labral involvement and contraindications for MRA.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Patients with subacute or chronic shoulder pain with symptoms of, or clinical suspicion of labral tears. Patients should generally have failed non-operative treatment including NSAID and waiting 4 to 6 weeks without trending towards resolution. MRA is generally preferable to CTA for imaging soft tissues, unless there are contraindications for MRI.

Benefits

Secure a diagnosis.

Harms

False positives and false negatives for labral tears. Arthrography improves the accuracy especially regarding complete rotator cuff tears and significant labral tears. Small risk of infection and complications from the injection.

Frequency/Dose/Duration

A second study is rarely needed, and should be based on significant changes in symptoms and examination.

Rationale

MR arthrograms have not been evaluated in quality studies. Although studies are heterogeneous, pooled estimates of the sensitivity for full-thickness tears is estimated at 95% with specificity 93% (Dinnes et al., 2003). There is a high prevalence of labral injury with a first shoulder dislocation based on MR arthrography (MRA) (Antonio et al., 2007). Arthrography with low-field MR was found to be equivalent to high-field in a series of 38 patients (Loew et al., 2000). A comparison of high- versus low-field MR imaging for SLAP tears among symptomatic patients found high field superior for diagnosing SLAP (Tung et al., 2000). The sensitivity of high field MRA was 90% and specificity 63%, while sensitivity for low field was 64% and 70% specificity. MRA was found superior to CT arthrography (CTA) and marginally better than MRI for identification of labral tears in a case series of patients with recurrent anterior instability, prior anterior dislocation or shoulder pain of unknown cause (Chandnani et al., 1993). MRA sensitivity for a labral tear was 96.4%, MRI was 92.9%, and CTA was 73.1%. Specificity was 100% for all three tests; however, this appears overstated as there were only two patients without a tear in this small case series. MR arthrography is invasive, has adverse effects including a low, but definite risk of infection and is painful. It is also costly, although MRA has been felt to provide better cost effectiveness than MRI or CT arthrography for select diagnoses (Oh et al., 1999). It is likely the best imaging procedure available for patients thought to have labral tears or patients with good strength in order to assess the labrum and rotator cuff with traumatic injury simultaneously, and is recommended for select use.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.4.5. MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for many shoulder joint problems since it tends to be helpful for imaging soft tissues, particularly the rotator cuff (596,598,599,594,593,600,184,592,601,597,57,595,591).

MRI FOR DIAGNOSING ACROMIOCLAVICULAR JOINT DISORDERS WHILE ALSO DIAGNOSING LABRAL TEARS

Sometimes Recommended

MRI is selectively recommended for patients with AC joint problems who are also suspected of having acute, clinically significant rotator cuff tears or other soft tissue concerns.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Patients thought to need imaging who not only have AC joint problems but who also have soft tissue concerns such as an acute, clinically significant rotator cuff tear. Patients with only bony concerns but needing imaging are recommended to instead undergo CT scanning which is superior for osseous imaging. Patients with concerns about AC joint pathology and labral tears may be better evaluated with CT Arthrography, while those with primarily soft tissue concerns accompanying a reasonably defined AC joint problem would be better candidates for MRA.

Benefits

Secure a diagnosis and identify a second disorder.

Harms

False positives and false negatives for rotator cuff tears.

Frequency/Dose/Duration

A second study is rarely needed, and should be based on significant changes in symptoms and examination.

Rationale

There are no quality studies identifying the need of MRI imaging for AC joint problems. CT is superior for osseous structure imaging, thus MRI use is limited to AC joint problems while also having concerns for soft tissue abnormalities such as rotator cuff tendinopathy. If there are concerns for labral involvement, concomitant arthrography (CT arthrography) may be preferable.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials,

random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.4.6. MAGNETIC RESONANCE ARTHROGRAM

Magnetic resonance (MR) arthrography combines an MRI with an arthrogram to overcome MRI limitations and is usually performed in preference to CT arthrography unless bony structure definition is needed as well (173,174). MR arthrography is particularly thought to be effective for imaging labral pathology (180,179,177,175,43,181,176).

MAGNETIC RESONANCE ARTHROGRAM FOR DIAGNOSING ACROMIOCLAVICULAR JOINT DISORDERS

Not Recommended

Magnetic resonance (MR) arthrography is not recommended for evaluating AC joint problems. For concerns about AC joint injury with labral involvement, CT arthrography would generally be preferable.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

MR arthrography is not recommended for evaluating AC joint problems. For concerns about AC joint injury with labral involvement, CT arthrography would generally be preferable for bony concerns. MRA may be indicated when there are less concerns for the AC joint, but there are concerns about soft tissues.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If

relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.4.7. ULTRASOUND

ULTRASOUND FOR DIAGNOSING ACROMIOCLAVICULAR JOINT DISORDERS

Not Recommended

Ultrasound is not recommended for evaluating AC joint problems.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Ultrasound is not recommended for evaluating AC joint problems. X-rays are preferable for visualizing the bony structures involved.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.4.8. SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT) FOR ACROMIOCLAVICULAR JOINT DISORDERS

Not Recommended

SPECT is not recommended for the evaluation of patients with AC Joint disorders.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain due to occupational injuries including AC

Joint disorders. One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning. Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating shoulder disorders.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.4.9. POSITRON EMISSION TOMOGRAPHY (PET)

POSITRON EMISSION TOMOGRAPHY (PET) FOR ACROMIOCLAVICULAR JOINT DISORDERS

Not Recommended

PET scanning is not recommended for the evaluation of patients with AC joint disorders.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain due to occupational injuries including AC joint disorders. One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning. Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating shoulder disorders.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials,

random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.4.10. DIAGNOSTIC INJECTIONS

Diagnostic injections are sometimes performed, particularly in the subacromial space, glenohumeral joint, and acromioclavicular joint. However, they are nearly always performed in combination with a therapeutic intervention, such as a glucocorticosteroid injection. Injection with a therapeutic agent is nearly always preferable because it is less invasive to perform only a single injection; in addition, the patient can be assessed both immediately post-injection for diagnostic purposes and over the longer term for therapeutic purposes.

13.5. TREATMENT RECOMMENDATIONS

13.5.1. INITIAL CARE

Initial care of an AC sprain or separation involves identification of the grade of injury, as well as of other accompanying disorders such as fractures, rotator cuff tendinopathies, and labral injuries, and treated accordingly (902). Over-the-counter analgesics and self-applications of ice and heat are recommended. Slings may be helpful acutely. Early range-of-motion exercises are recommended.

SLINGS FOR TREATMENT OF ACROMIOCLAVICULAR SPRAINS OR DISLOCATIONS

Recommended

Slings are selectively recommended for treatment of acromioclavicular sprains or dislocations.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Acute severe AC spains, particularly where the appliance is utilized as part of a plan to briefly rest the shoulder and promptly, gradually increase activity level. Non-operative patients are recommended to have an ROM exercise program instituted in nearly all circumstances.

Benefits

Short-term improvement in pain. Equivalent clinical results to surgical management but without risk of surgery (Society, 2015) (Joukainen et al., 2014) (Mah, 2017) (Murray et al., 2018) (Windhamre et al., 2022).

Harms

Delayed recovery, development of adhesive capsulitis and debility.

Indications for Discontinuation

Generally should be weaned off within 1-2 weeks.

Rationale

There are no quality studies comparing slings with other devices. There are many quality trials comparing various operative techniques with non-operative management, with all trials suggesting equivalent clinical recovery with non-operative management (Society, 2015) (Joukainen et al., 2014) (Mah, 2017) (Murray et al., 2018) (Windhamre et al., 2022). Short-term use of slings and supports may help with short-term pain reductions. However, they come with considerable increased risks of adhesive capsulitis, delayed recovery and increased debility. Thus, slings and supports are selectively recommended for only shoulder severe pain and short-term use after surgery and acute severe pain. Range of motion exercises are generally advised (e.g., pendulum, wall-walks) during the time when using the sling. Generally wean of the support use within 1-2 weeks.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.5.2. MEDICATIONS

Over-the-counter (OTC) medications, particularly NSAIDs, may be helpful for pain management and provide sufficient relieve for many Grade I and II AC sprains (908,907,902). Select patients may require judicious use of opioids for pain management. Patients may also require medications post-operatively.

There is no quality literature specific to AC joint disorders for nearly all of the following interventions. In the absence of quality evidence, it is recommended that AC joint disorders be managed according to the recommendations for Rotator Cuff Tendinopathy and Shoulder Pain:

- NSAIDs for Treatment of Rotator Cuff Tendinopathies and Shoulder Pain *[Strongly Recommended, Evidence (A)]*

- Acetaminophen for Acute, Subacute, Chronic, or Post-operative Shoulder Pain *[Recommended, Insufficient Evidence (I)]*
- Norepinephrine Reuptake Inhibiting Anti-depressants for Subacute or Chronic Shoulder Girdle Pain *[Recommended, Insufficient Evidence (I)]*
- Selective Serotonin Reuptake Inhibitors for Acute, Subacute, or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Anti-convulsants for Acute, Subacute or Chronic Shoulder Pain and Rotator Cuff Tendinopathies *[Not Recommended, Insufficient Evidence (I)]*
- Capsicum Creams for Acute, Subacute, Chronic Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*
- Topical NSAIDs, including Diclofenac Epolamine for Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*
- Topical Glyceryl Trinitrate, Lidocaine Patches, Eutectic Mixture of Local Anesthetics (EMLA), and Other Creams/Ointments for Shoulder Pain and Rotator Cuff Tendinopathy *[Not Recommended, Insufficient Evidence (I)]*

See also the ACOEM Opioids guideline for the treatment of subacute and chronic pain.

13.5.3. ACTIVITY MODIFICATION AND EXERCISE

THERAPY FOR TREATMENT OF SEVERE ACROMIOCLAVICULAR SPRAINS OR DISLOCATIONS

Recommended

Therapy, including exercises and education, is recommended for patients with moderate to severe acromioclavicular sprains, or dislocations, or who are in need of surgery.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Acromioclavicular sprains and separations, as well as post-operative use (Nuber et al., 1997, Lemos, 1998).

Benefits

Earlier recovery of function

Harms

Negligible

Frequency/Dose/Duration

Pendulum exercises are generally initiated, along with other ROM exercises and education. These are typically followed by isometric strengthening program, then isotonic strengthening and endurance exercises. Programs require individualization based on factors such as patient's injury severity, age, experience, comorbid conditions, and compliance. A range of options includes weekly appointments to oversee and advance a home exercise program for several weeks until sufficiently recovered for lower grade injuries and self-motivated patients. Patients with more severe injuries or need for supervision may require appointments 2 to 3 a week to initiate program exercises, tapering to 1 a week in approximately 4 weeks before being discharged to a home-exercise program in approximately

2 months for more severe injuries. Results of the exercise prescription should be regularly monitored and failure to progressively improve is an indication to either revisit the differential diagnosis and/or seek a second opinion/consultation, particularly by the time approximately 6-12 therapy appointments is reached.

Indications for Discontinuation

Recovery of function, resolution of pain, non-compliance

Rationale

Education is often helpful for patient understanding of the condition and to facilitate exercises, especially in the post-operative period.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder dislocation, shoulder instability; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 5,125 articles in PubMed, 106,000 in Google Scholar, and 0 from other sources†. We considered for inclusion 28 from PubMed, 16 from Google Scholar, and 0 from other sources. Of the 44 articles considered for inclusion, 4 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.5.4. INJECTION THERAPIES

Injections are generally not indicated for AC sprains and separations. However, they are sometimes utilized for treatment of patients who have other conditions such as rotator cuff tendinopathies or who have an injection for combined diagnostic and therapeutic purposes. An injection may be indicated for patients who have delayed recovery for unclear reasons in whom an empiric injection for diagnostic and therapeutic purposes is performed (see Rotator Cuff Tendinopathy Injections). An injection is recommended prior to consideration of distal clavicle resection for patients with ongoing pain of at least 6 months to ascertain whether the injection will resolve the pain; then if the pain recurs after an injection, this may help ascertain whether distal clavicle resection may be successful. An AC joint injection is also potentially indicated for a patient with ongoing pain for at least 3 months after injury and lack of resolution or improvement with NSAIDs and exercise.

For intraarticular shoulder viscosupplementation injections, see Knee Osteoarthrosis for most relevant literature that is used under the assumption of physiological similarity.

GLUCOCORTICOSTEROID INJECTIONS FOR ACUTE TREATMENT OF ACROMIOCLAVICULAR SPRAINS OR DISLOCATIONS

Not Recommended

Glucocorticosteroid injections are not recommended for the treatment of acute isolated acromioclavicular sprains or dislocations.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There is no quality evidence and no sound rationale for injections for acute AC sprains to alter and improve on the naturally good prognosis for these problems and thus they are not recommended. Steroid injections may be indicated for short-term relief of arthritis (see Osteoarthrosis).

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

GLUCOCORTICOSTEROID INJECTIONS FOR CHRONIC ACROMIOCLAVICULAR JOINT PAIN

Recommended

A glucocorticosteroid injection is selectively recommended prior to consideration of distal clavicle resection for patients with ongoing pain of at least 6 to 12 months to ascertain whether the injection will resolve the pain. If an injection resolves the pain and the pain recurs, then it helps define that distal clavicle resection may be more likely to be successful provided there is no acromioclavicular instability.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients with ongoing pain of at least 6 to 12 months and for whom surgery is considered.

Benefits

Improvement or resolution of pain, clarification of the pain source, improved predictability of surgical success

Harms

Rare infection

Frequency/Dose/Duration

Dose is unclear as there are no controlled trials evaluating dosage. Simultaneous administration of a local anesthetic with a glucocorticosteroid is highly recommended to ascertain whether there is immediate relief on injection.

Rationale

There are no quality trials. An injection is recommended prior to consideration of distal clavicle resection for patients with ongoing pain of at least 6 months to ascertain whether the injection will resolve the pain; if an injection then resolves the pain and the pain recurs, it may suggest that to suggest whether distal clavicle resection may be successful and should be recommended for grade I or II acromioclavicular dislocations. An AC joint injection is also potentially indicated for a patient with ongoing pain for at least 3 months after injury and lack of resolution or improvement with NSAIDs and exercise.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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13.5.5. ALLIED HEALTH INTERVENTIONS

TAPING FOR TREATMENT OF ACROMIOCLAVICULAR SPRAINS OR DISLOCATIONS

Not Recommended

Taping is not recommended for the treatment of acromioclavicular sprains or dislocations.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Taping has been evaluated in quality trials for other musculoskeletal disorders, including low back pain, and was found to be ineffective. Thus, it is not recommended for treatment of acromioclavicular sprains or dislocations.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MAGNETS FOR TREATMENT OF ACROMIOCLAVICULAR SPRAINS OR DISLOCATIONS

Not Recommended

Magnets are not recommended for the treatment of acromioclavicular sprains or dislocations.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Magnets have been evaluated in quality trials for other musculoskeletal disorders, including low back pain, and was found to be ineffective. Thus, they are not recommended for treatment of acromioclavicular sprains or dislocations.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms.

Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PULSED ELECTROMAGNETIC FREQUENCY FOR TREATMENT OF ACROMIOCLAVICULAR SPRAINS OR DISLOCATIONS

Not Recommended

Pulsed electromagnetic frequency is not recommended for the treatment of acromioclavicular sprains or dislocations.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Pulsed electromagnetic frequency has been evaluated in quality trials for other musculoskeletal disorders, including low back pain, and was found to be ineffective. Thus, it is not recommended for treatment of acromioclavicular sprains or dislocations.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INTERFERENTIAL THERAPY FOR TREATMENT OF ACROMIOCLAVICULAR SPRAINS OR DISLOCATIONS

Not Recommended

Interferential therapy is not recommended for the treatment of acromioclavicular sprains or dislocations.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Interferential therapy has been evaluated in quality trials for other musculoskeletal disorders, including low back pain, and was found to be ineffective. Thus, it is not recommended for treatment of acromioclavicular sprains or dislocations.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

OTHER PHYSICAL MODALITIES FOR TREATMENT OF ACROMIOCLAVICULAR SPRAINS OR DISLOCATIONS

No Recommendation

There is no recommendation for or against the use of diathermy, infrared therapy, ultrasound, laser therapy, manual therapy, mobilization, manipulation, massage, high-voltage galvanic, H-Wave® device stimulation, iontophoresis, microcurrent, percutaneous electrical nerve stimulation (PENS), sympathetic electrotherapy, or transcutaneous electrical stimulation (TENS) for treatment of acromioclavicular sprains or dislocations.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies and the clinical benefit remains uncertain. Thus there is no recommendation for or against the use of diathermy, infrared therapy, ultrasound, laser therapy, manual therapy, mobilization, manipulation, massage, high-voltage galvanic, H-wave stimulation, iontophoresis, microcurrent, percutaneous electrical nerve stimulation (PENS), sympathetic electrotherapy, or transcutaneous electrical stimulation (TENS) for treatment of acromioclavicular sprains or dislocations.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476

articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.5.6. SURGICAL CONSIDERATIONS

Grade I and II AC sprains are managed non-operatively (2148,2149,2150,2151,2152,902). Patients with AC joint separation managed non-operatively should anticipate pain for approximately 3 weeks, with pain gradually decreasing. If pain persists after recovery and return to activities, resection of the outer clavicle may be indicated after 6 months to 1 year, although local cortisone injection(s) should generally be attempted. The initial deformity may decrease as healing and scar contracture takes place. Persistence of the deformity is not an indication for surgery. In one series, 79% of patients with moderate-to-severe AC separations had good-to-excellent late results with non-operative treatment; of the remainder, 90% had good-to-excellent results with simple excision of the outer clavicle.

Grade III separations have been managed both surgically and non-operatively; however, multiple reviews have opined the evidence fails to clearly support a need for surgery and some outcomes were better in the non-operatively treated patients (2153,2154,2150,2148,2155,2149), other than potentially improved appearance (2156,2150,2153). Late symptoms, without surgery, include popping (sometimes painful), clicking, painful AC joint, and arthrosis.

Grades IV to VI have been mostly managed surgically (2157), although some are managed non-operatively. Surgical approaches include acromioclavicular reduction, coracoclavicular ligament repair, coracoclavicular screw fixation, cerclage wire, autologous tissue coracoclavicular ligament reconstruction, acromioclavicular ligament reconstruction, and hook plates (2158,2159,2160,905,2161,2162,2163,2164,2165,2166,2167,2168,2150,2169,2154,2151,2170,2171, 2172,2173,715,2153,2174,2175,2176,2177,2178,2179,2180,902). However, there are no quality trials to define an optimal surgical approach or procedure. The AC joint has a fibrocartilaginous disk that exists but degenerates and involutes with age (2181), although it is frequently removed from injured joints of younger patients.

NON-OPERATIVE MANAGEMENT OF ACROMIOCLAVICULAR JOINT SPRAIN – GRADES I TO II

Recommended

Non-operative management is recommended as the initial treatment for patients with Grade I to II acromioclavicular joint sprains.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Grade I to II acromioclavicular joint sprains.

Benefits

Earlier recovery of function

Harms

Negligible

Rationale

There are no quality trials comparing surgical with non-operative management of Grades I to II acromioclavicular joint separations. The former are believed to be satisfactorily addressed conservatively with excellent results and the latter are thought to be an indication for surgical treatment. As there is no quality evidence of efficacy of surgery and non-operative management is often successful, non-operative management is recommended for at least 6 months.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 36 articles considered for inclusion, 5 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SURGICAL GRAFTING FOR ACROMIOCLAVICULAR JOINT SEPARATION

No Recommendation

There is no recommendation for or against surgical grafting for acromioclavicular joint separations.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are two small studies, one of which may have a randomization failure, resulting in a sparse database from which to draw meaningful conclusions. Thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation;

controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 36 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ROUTINE SURGICAL REPAIR OF ACROMIOCLAVICULAR JOINT SEPARATION – GRADE III

Not Recommended

Routine surgical repair is moderately not recommended for Grade III acromioclavicular joint separations (Larsen et al., 1986, Bannister et al., 1989).
Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Rationale

There are multiple moderate-quality trials comparing non-operative with operative management of Grade III AC separations (Larsen et al., 1986, Bannister et al., 1989, Joukainen et al., 2014, Society, 2007, Mah, 2017, Murray et al., 2018, Windhamre et al., 2022), with a few trials including Rockwood Type IV (Society, 2007, Mah, 2017, Murray et al., 2018) and a couple including Rockwood Type V (Society, 2007, Mah, 2017, Windhamre et al., 2022). Studies consistently report equivalent clinical results but faster recovery and earlier return to work and sports. Yet, surgical treatment is associated with higher complications in the operatively managed group (Bannister et al., 1989), and multiple other case series document complications in surgically managed patients. Surgery is invasive, has adverse effects, and is high cost. It is not recommended for the vast majority of Grade III AC separations. However, there may be patients with either particularly severe separations or with high physical demands who may potentially benefit from such an intervention. Thus, there is a separate recommendation for consideration of surgery for those selected patient groups.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 36 articles considered for inclusion, 15 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search,

and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SURGICAL REPAIR OF ACROMIOCLAVICULAR JOINT SEPARATION FOR SELECT PATIENTS – GRADES III

Sometimes Recommended

Surgical repair is recommended for highly select patients with Grade III acromioclavicular joint separations.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Symptomatic Grade III acromioclavicular joint separation in patients with concerns about cosmesis, or those with unusually high physical occupational or sports demands, particularly if there are symptoms not trending towards resolution over at least a month (Larsen et al., 1986).

Benefits

Theoretical potential for improved outcomes

Harms

Surgical complications including infection

Rationale

There are multiple moderate-quality trials comparing non-operative with operative management of Grade III AC separations (Larsen et al., 1986, Bannister et al., 1989, Joukainen et al., 2014, Society, 2007, Mah, 2017, Murray et al., 2018, Windhamre et al., 2022), with a couple trials including Rockwood Type IV (Society, 2015, Mah, 2017, Murray et al., 2018) and a couple including Rockwood Type V (Society, 2015, Mah, 2017, Windhamre et al., 2022). Studies consistently report equivalent clinical results but faster recovery and earlier return to work and sports. Yet, surgical treatment is associated with higher complications in the operatively managed group (Bannister et al., 1989), and multiple other case series document complications in surgically managed patients. Surgery is invasive, has adverse effects, and is high cost. It is not recommended for the vast majority of Grade III AC separations. However, there may be patients with either particularly severe separations or with high physical demands who may theoretically benefit, thus there is a recommendation for consideration of surgery for those highly select groups.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion

30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SURGICAL REPAIR OF ACROMIOCLAVICULAR JOINT SEPARATION – GRADES IV TO VI

Recommended

Surgical repair is recommended for treatment of Grades IV to VI acromioclavicular joint separation.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Symptomatic Grade IV to VI acromioclavicular joint separation.

Benefits

Theoretical potential for improved outcomes

Harms

Surgical complications including infection

Rationale

There are a few trials including Rockwood Type IV (Society, 2015, Mah, 2017, Murray et al., 2018) and a couple including Rockwood Type V (Society, 2015, Mah, 2017, Windhamre et al., 2022) suggesting non-operative management is an option. However, most of these have been managed surgically (Yan et al., 2017). Surgical approaches include acromioclavicular reduction, coracoclavicular ligament repair, coracoclavicular screw fixation, cerclage wire, autologous tissue coracoclavicular ligament reconstruction, acromioclavicular ligament reconstruction, and hook plates (Bosworth, 1941, Dewar et al., 1965, Norrell et al., 1965, Allman, 1967, Weaver et al., 1972, Ejeskar, 1974, Katznelson et al., 1976, Sethi et al., 1976, Bargren et al., 1978, Vainionpaa et al., 1981, Paavolainen et al., 1983, Vandekerckhove et al., 1985, Eskola et al., 1987, Taft et al., 1987, Ho et al., 1988, Skjeldal et al., 1988, Bannister et al., 1989, Ferris et al., 1989, Jalovaara et al., 1991, Morrison et al., 1995, Sim et al., 1995, Levine et al., 1998, Phillips et al., 1998, Faraj et al., 2001, Jones et al., 2001, Boldin et al., 2004, Stewart et al., 2004, Lafosse et al., 2005, LaPrade et al., 2005, Yoo et al., 2006, Wang et al., 2008, Simovitch et al., 2009, Fauci et al., 2013, Darabos et al., 2015, Wang, 2021, Ye et al., 2016, Xu et al., 2017, Cai, 2018, Müller et al., 2018, Shui et al., 2018, Yin et al., 2018, Abdelrahman et al., 2019, Lu et al., 2016, Sun et al., 2019). There also are no quality trials to define an optimal surgical approach or procedure for a given condition. The AC joint has a fibrocartilaginous disk that exists, but degenerates and involutes with age (DePalma, 1959), although it is frequently removed from injured joints of younger patients. These more severe AC sprains are thought to obtain superior outcomes with surgery and thus surgery is recommended for Grades IV to VI AC sprains.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ARTHROSCOPIC OR MINIMALLY INVASIVE SURGERY FOR ACROMIOCLAVICULAR JOINT DISLOCATIONS

Recommended

Arthroscopic or minimally invasive surgical techniques are recommended for acromioclavicular joint separations.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Grade III-V AC separations thought to need surgical repair.

Benefits

Potential improved function, reduced symptoms and cosmesis.

Harms

Infection, operative complications

Rationale

An RCT comparing open with arthroscopic repair with TightRope systems of Rockwood III-IV AC separations found similar results (Abdelrahman et al., 2019). One comparative trial suggested similar results with a one- vs. two-button technique for Rockwood Types III-V AC separations (Sun et al., 2019). Another trial comparing the TightRope system with screw found comparable results for Rockwood III AC separations, although satisfaction was higher with the former (Darabos et al., 2015). A trial comparing clavicular hook plate with TightRope wire for Rockwood III separations found less operations were needed with the TightRope wire (Cai, 2018). There is one trial comparing open with arthroscopic repair and suggested comparable results. The other quality RCTs use different techniques

for varying types of AC separation, although they nevertheless suggest potential efficacy of arthroscopic and/or minimally invasive surgical procedures and thus they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 36 articles considered for inclusion, 7 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.5.7. POSTOPERATIVE REHABILITATION

Different rehabilitation protocols have been reported for AC separations (902). One post-operative rehabilitation protocol entails use of a sling and cold therapy device. At 2 weeks, active and passive ROM exercises are initiated. Full active and passive ROM exercises are added when the screw is removed at 2 to 3 months. Progressive strengthening is then prescribed for 6 to 8 weeks (902). Individualization of these protocols is likely required based on various factors, including immediate operative results, age, conditioning, compliance, and prior experiences. Rehabilitation programs should include education.

REHABILITATION FOR PATIENTS AFTER SURGICAL REPAIR OF ACROMIOCLAVICULAR SEPARATIONS

Recommended

Rehabilitation is recommended for patients after surgical repair of acromioclavicular sprains/separations.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Surgical repairs of AC separations. Individualization is recommended based on various factors, including immediate operative results, age, conditioning, compliance, and prior experiences.

Benefits

Improved function and earlier recovery

Harms

Negligible

Frequency/Dose/Duration

Weekly to 3 times a week for the first 2 weeks, then weekly to twice weekly for the next 4 weeks, then weekly to twice weekly for the following 6 to 8 weeks.

Indications for Discontinuation

Recovery, plateau in recovery, noncompliance, or intolerance

Rationale

There are no quality trials evaluating rehabilitation for AC separation patients (Simovitch et al., 2009). One trial suggested that outcomes were not affected by the posture (erect or supine) posture used during rehabilitation sessions (Ibrahim et al., 2020). However, exercises appear necessary, and education along with a home-exercise program appears to be required for nearly all patients. Rehabilitation is not invasive, has low adverse effects, is moderate to high cost, but is important for optimal recovery for many of these patients and is thus recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: acromioclavicular joint sprains, acromioclavicular joint strains, acromioclavicular joint dislocations, acromioclavicular sprain, acromioclavicular dislocation; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 476 articles in PubMed, 8,500 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 36 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

13.5.8. FOLLOW-UP VISITS

Patients with AC sprains generally require a few follow-up appointments for purposes of monitoring symptoms, advancing treatment, and gradually reducing limitations as the sprain resolves. Patients with more severe sprains, slower resolution, in need of operative care, or with other accompanying disorders will require a considerably greater number of appointments. Frequencies of appointments may also be greater where workplace limitations are required and job demands are higher. Early post-operative rehabilitation is advanced slowly to protect the repair.

14. SHOULDER FRACTURES

14.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing shoulder fractures from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

14.2. OVERVIEW

Shoulder fractures are common in all age groups, from youth engaged in sports to adults in motor vehicle crashes to elderly who have fallen (2182,2183,2184,2185,2186,2187,2188,2189). Many elderly patients are in relatively poor health and susceptible to other fractures (919,2190,2191,2192,2193,2194,2195). A minority of shoulder fractures occur in the course of employment, from falls, falls from heights, motor vehicle crashes (2196,2197,2198), and industrial crush injuries (2197). Most quality evidence for osteopenic and osteoporotic patients is found in the literature addressing hip fractures (see Hip and Groin Disorders Guideline). Among patients with shoulder fractures, especially those with risks for osteoporosis, assessment of bone quality is recommended for purposes of secondary prevention. Treatment options include calcium and vitamin D supplementation to correct deficiencies (2199,2200) and bisphosphonates for those with low bone mass density, but also include adequate dietary and/or supplementary calcium and vitamin D (2201,2202,2199). There also is consideration for anabolic steroids (2201).

Proximal humeral fractures are among the most common fractures and are the predominant shoulder fracture in the elderly (2192,2184,2189,2191,919). Approximately 50 to 80% of proximal humeral fractures may be treated non-operatively (2184,2189,919,912,2203,913,914,2204,2205,2206,2207,2208). Surgery has been suggested for more complex fractures (2203), but there is not a consensus (2209). Surgery increases rates of complications including hardware-related, osteonecrosis, and infection (2203,2210,2211,2212,2213,2214,2215). The overall quality of available evidence for the treatment of shoulder fractures is weak.

Fractures of the scapula occur infrequently and constitute less than 5% of shoulder fractures (2216,2217,2218,2219). However, many scapular fracture patients have other injuries, such as thoracic and/or head injuries (2218,2219,2220,936,2221,2222,940,937,2223); thus, careful evaluation and management is recommended. There are no quality trials evaluating scapula fracture treatment. Many scapular fractures may be managed non-operatively (2220,2224). However, some fractures are managed surgically, particularly when they involve the displaced glenoid or scapular neck fractures, lateral margin of the acromial process, or displaced coracoids fractures, severely displaced scapular

body fractures (936,2224,2225,2226,2227,2228,2229,2230,2231,2232,2233,2234,2235,2236,2237,2238,2239,2240,2241).

Clavicular fractures are addressed separately (see Clavicular Fractures).

14.3. WORK LIMITATIONS

Shoulder fractures generally require work limitations. Limitations typically include no use of the affected extremity and gradually allow increased use as healing occurs.

14.4. DIAGNOSTIC RECOMMENDATIONS

14.4.1. X-RAYS

X-RAYS FOR SHOULDER OR CLAVICULAR FRACTURES

Recommended

X-rays are recommended for evaluation of shoulder or clavicular fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

All patients suspected of having shoulder or clavicular fractures, as well as those with trauma without suspicion of fracture to help rule out fracture. Scapular views are required to evaluate scapular fractures.

Benefits

Diagnosis of a fracture, calcific tendinitis, or otherwise latent medical condition(s).

Harms

Medicalization or worsening of otherwise benign shoulder condition; minor radiation exposure.

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient with two to three views. After initially negative x-rays, a second set of x-rays 7-14 days after trauma is advisable if there is either a suspicion of fracture or lack of major interval improvements. For patients with chronic shoulder pain, it may be reasonable to obtain another set of x-rays later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

X-rays are helpful to evaluate for fracture. They also assist in differential diagnostic possibilities such as tendinosis, calcific tendinitis, and arthroses, which result in different treatment options. X-rays are non-invasive, low to moderate costly, and have little risk of adverse effects, and therefore are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

14.4.2. DIAGNOSTIC ARTHROSCOPY

While arthroscopy is not indicated for simple fractures, there are other indications. See Rotator Cuff Tendinopathy.

14.4.3. BONE SCANS

While bone scanning is not indicated for simple fractures, there are other indications. See Rotator Cuff Tendinopathy.

14.4.4. COMPUTED TOMOGRAPHY

Computed tomography remains an important imaging procedure, particularly for bony anatomy, whereas MRI is superior for soft tissue abnormalities. However, most patients have issues with soft tissue rather than bony abnormalities in the shoulder, thus on a population-basis, far fewer CT scans are ordered. CT may nevertheless be useful for shoulder joint abnormalities where advanced imaging of the bones is required (i.e., complex proximal humerus fracture, scapular fracture). CT also may be useful to evaluate the anatomy in patients with contraindications for MRI (most typically an implanted metallic-ferrous device). CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – glenoid deficiency and humeral Hill-Sachs – as MRI is not as good for bone imaging. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear.

COMPUTED TOMOGRAPHY FOR EVALUATION OF SHOULDER FRACTURES

Sometimes Recommended

Computed tomography is selectively recommended for the evaluation of complex proximal humeral and glenoid/scapular fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Imaging for complex proximal humeral and glenoid/scapular fractures or other calcified structures. For most shoulder fractures, x-rays suffice. CT may also be indicated as well for scapular fractures with concerns about thoracic injury. CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – glenoid deficiency and humeral Hill-Sachs – as MRI is not as good for bone imaging.

Benefits

Diagnosis and understanding of the degree of complex fractures, calcific tendinitis.

Harms

Radiation exposure.

Frequency/Dose/Duration

Obtaining a CT once is generally sufficient. For patients with chronic shoulder pain, it may be reasonable to obtain a second CT later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

X-rays are sufficient for most fracture patient evaluations; however, CT is superior where imaging calcified structures is required, such as for complex proximal humeral and glenoid/scapular fractures. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear. MRI is considered superior to computerized tomography for imaging most shoulder abnormalities where advanced imaging of soft tissues is usually the primary concern. A contrast CT study is minimally invasive, has few, if any, adverse effects but is costly. It is recommended for select use.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search,

and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

14.4.5. MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for many shoulder joint problems since it tends to be helpful for imaging soft tissues, particularly the rotator cuff.

MAGNETIC RESONANCE IMAGING FOR SHOULDER OR CLAVICULAR FRACTURES

Sometimes Recommended

MRI is selectively recommended for patients with shoulder or clavicular fractures who are also suspected of having acute, clinically significant rotator cuff tears. It is also recommended for select patients with subacute or chronic shoulder pain thought to potentially have a symptomatic rotator cuff tear.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Patients with shoulder fractures who are also thought to have an acute, clinically significant rotator cuff tear or subacute or chronic shoulder pain suspected of having a rotator cuff tear. If there is significant rotator cuff weakness, immediate imaging may be indicated. MRI may be indicated as well for scapular fractures with concerns about thoracic injury. Exceptions include elderly patients, those who would not undergo surgical repair, or those who have substantial signs of pre-existing large/massive rotator cuff tear. It is also reasonable to wait for 1 or 2 weeks to ascertain whether the condition is likely to resolve with conservative care without obtaining an MRI. Most acute tears without significant weakness should wait 2+ weeks prior to imaging as some patients with acute pain and limited ROM resolve clinically. Those with subacute or chronic pain should generally have failed additional non-operative treatment including NSAID, exercise after fracture healing and injection(s).

Benefits

Secure a secondary diagnosis.

Harms

False positives and false negatives for rotator cuff tears.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

One moderate-quality study compared MRI with arthrography, suggesting MRI is superior to arthrography to evaluate for rotator cuff tears (Blanchard et al., 1999); however, arthrography alone has been largely replaced by other procedures. Otherwise, MRI has not been evaluated in high-quality

studies for shoulder joint pathology (Dinnes et al., 2003, Leunig et al., 2004, Kassarjian et al., 2005). MRI appears particularly helpful for soft tissue abnormalities and has been suggested for evaluations of patients with symptoms over 3 months (Bredella et al., 2005, Kassarjian et al., 2005). MRI was compared with arthroscopy in 57 patients with shoulder pain of unclear cause (Torstensen et al., 1999). MRI was found to be accurate in detecting 68% of rotator cuff tears and 62% accurate in detecting labral injuries. MRI sensitivity for RC tears was 96% and specificity 49% (for labral tears, 73% sensitive, 58% specific). The authors concluded that "MRI does not appear to be an accurate effective tool for assessing shoulder pathologic conditions in patients in whom the clinical picture is not clear and therefore may not be of assistance in surgical planning for patients with these difficult conditions."

MRI was compared with arthroscopic findings among 16 patients with trauma (Kirkley et al., 2003). The authors found moderate correlation for superior labral lesions (k = 0.60), fair agreement for rotator cuff tear (k = 0.355), Hill-Sachs (k = 1.0), and moderate for size (k = 0.44). A consecutive case series of 104 patients with shoulder problems were evaluated and randomized to MRI first versus arthrography first. There were modestly fewer changes in diagnostic categories with MRI (30%) than arthrography (37%), p >0.5. MRI led to slightly more changes in planned therapy (36% vs. 25%, p >0.3). MRI was found to be 79% accurate, 81% sensitive and 78% specific for full-thickness rotator cuff tears. Arthrography was found to be 82% accurate, 50% sensitive and 96% specific (Blanchard et al., 1999). A cross-sectional comparison of MRI (1.5T loop-gap resonator surface coil), double-contrast arthrography, high-resolution sonography, and surgery among 38 patients with suspected rotator cuff tears did not include all patients receiving all tests or surgery (other than MRI and arthrography) and reported a sensitivity of MRI of 100% (Burkhead WZ, 2007). Ultrasound detected 9/15 (60%) of tears. However, the study population was small and biased in favor of overestimating the tests' sensitivity.
MRI has shown increased changes in the rotator cuff and tears with increased age (Sher et al., 1995, Needell et al., 1996), as well as a high prevalence of bony and peritendinous shoulder abnormalities among those without symptoms (Needell et al., 1996). MRI has reasonably good operant characteristics for full-thickness tears, although it does not have good sensitivity for partial thickness tears (Dinnes et al., 2003). Fatty infiltration of the rotator cuff tendons is also found on MRI and thought to signify chronicity as well as portending a poorer surgical outcome (Berhouet et al., 2009). A comparative assessment of T-2 weighted fast spin-echo technique with vs. without fat-suppression MRI for assessment of rotator cuff tears among 177 patients thought to have tears found no differences in assessments of complete tears, but differed in interpretations of partial tears (Singson et al., 1996). Compared with surgery, sensitivity was 100% for full-thickness tears and specificity for intact tendons was 86%. Fat suppression was felt helpful for partial tears. MRI demonstrates acromial abnormalities and there is a higher prevalence of Type 3 acromion processes among those with either rotator cuff tear or impingement syndrome (Epstein et al., 1993). It has been suggested increased T2 signal in the distal clavicle may be an indication for surgical resection.

MRIs are considered the gold standard for evaluation of osteonecrosis patients and are used to quantify volume of affected tissue including marrow edema which is inversely correlated with prognosis (Coombs et al., 1994, Koo et al., 1995, Scheiber et al., 1999, Cherian et al., 2003, Radke et al., 2003, Jones et al., 2004, Harreld et al., 2009).

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for many shoulder joint problems since it tends to be helpful for imaging soft tissues, particularly the rotator cuff (Cartland et al., 1992, Tirman et al., 1994, Wnorowski et al., 1997, Connell et al., 1999, Tuite et al., 2000, Tung et al., 2000, Ardic et al., 2006, Chang et al., 2006, Reuss et al., 2006, Chang et al., 2008, Pandya et al., 2008, McFarland et al., 2009, Mulyadi et al., 2009). Although studies are not

heterogeneous, pooled estimates of the sensitivity for full-thickness tears has been calculated and is 89% with specificity 93%, while for partial thickness tears, these estimates are only 44% sensitivity and 90% specificity (Dinnes et al., 2003). Similarly accuracy is lower for smaller than larger tears (Yamakawa et al., 2001). There are concerns that MRI is inferior to MR arthrography for evaluating the labrum (Schmerl et al., 2005); thus, MRA is recommended for evaluation of the joint.

MRI is not invasive, has potential adverse effects from issues of claustrophobia or complications of medication, but is costly. MRI is not recommended for routine shoulder imaging and is not indicated solely to evaluate fractures, especially because CT is superior for osseous imaging. However, it is recommended for select shoulder joint pathology particularly involving concerns regarding secondary soft tissue pathology.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Of the 29 articles considered for inclusion, 1 diagnostic study and 0 systematic reviews met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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14.4.6. MAGNETIC RESONANCE ARTHROGRAM

Magnetic resonance (MR) arthrography combines an MRI with an arthrogram to overcome MRI limitations and is usually performed in preference to CT arthrography unless bony structure definition is needed as well. MR arthrography is particularly thought to be effective for imaging labral pathology.

MAGNETIC RESONANCE ARTHROGRAM FOR DIAGNOSING SHOULDER OR CLAVICULAR FRACTURES

Sometimes Recommended

Magnetic resonance arthrography (MRA) is selectively recommended for diagnosing labral tears in patients with shoulder or clavicular fracture(s).
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Patients with shoulder fracture(s) who also have symptoms of, or clinical suspicion of labral tears. Patients should generally have failed non-operative treatment of the labral tear or soft tissue including NSAID and waiting 4 to 6 weeks without trending towards resolution.

Benefits

Secure a diagnosis.

Harms

False positives and false negatives for labral tears. Arthrography improves the accuracy especially regarding complete rotator cuff tears and significant labral tears. Small risk of infection and complications from the injection.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

MRA has not been evaluated in quality studies among patients with shoulder fracture(s). Although studies are heterogeneous, pooled estimates of the sensitivity for full-thickness tears is estimated at 95% with specificity 93% (Dinnes et al., 2003). There is high prevalence for labral injury with first shoulder dislocation based on MRA (Antonio et al., 2007). Arthrography with low-field MR was found to be equivalent to high-field in a series of 38 patients (Loew et al., 2000). A comparison of high- versus low-field MR imaging for SLAP tears among symptomatic patients found high field superior for diagnosing SLAP (Tung et al., 2000). The sensitivity of high field MRA was 90% and specificity was 63%, while sensitivity for low field was 64% and 70% specificity. MRA was found superior to CT arthrography (CTA) and marginally better than MRI for identification of labral tears in a case series of patients with recurrent anterior instability, prior anterior dislocation, or shoulder pain of unknown cause (Chandnani et al., 1993). MRA sensitivity for a labral tear was 96.4%, MRI was 92.9%, and CTA was 73.1%. Specificity was 100% for all three tests; however, this appears overstated as there were only two patients without a tear in this small case series.

MR arthrography is invasive, has adverse effects (including a low but definite risk of infection), and is painful. It is also costly, although MRA is believed to provide better cost effectiveness than MRI or CT arthrography for select diagnoses (Oh et al., 1999). It is likely the best imaging procedure available for

patients thought to have labral tears or patients with good strength in order to assess the labrum and rotator cuff with traumatic injury simultaneously, and is recommended for select use.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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14.4.7. ULTRASOUND

Diagnostic ultrasound has been used for evaluating rotator cuff tears.

ULTRASOUND FOR DIAGNOSING SHOULDER OR CLAVICULAR FRACTURES

Sometimes Recommended

Ultrasound is selectively recommended for shoulder or clavicular fracture patients also suspected of having rotator cuff tears, tendinoses, or impingement.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Ultrasound technicians should have sufficient skill to obviate the need for scanning (Boykin et al., 2010, Hanchard et al., 2013); otherwise, the test introduces unnecessary redundancy. Patients with shoulder fracture(s) who also have symptoms and signs of a clinically significant rotator cuff tear, tendinosis, or impingement (Naredo et al., 1999, Iannotti et al., 2005, Ardic et al., 2006, Wall et al., 2012). Most clinical presentations should wait approximately 2 weeks prior to imaging as some patients with acute pain and limited range of motion resolve clinically; obvious tears are an exception to waiting two weeks. Those with subacute or chronic pain should generally have failed additional non-operative treatment including NSAID, exercise, and injection(s) (Moosikasuwan et al., 2005,

Ottenheijm et al., 2010). A MR arthrogram is recommended for suspected labral injury (see below) (Ardic et al., 2006).

Benefits

Secure a diagnosis.

Harms

False positives and false negatives.

Frequency/Dose/Duration

Repeat ultrasound should be based on significant change in symptoms and/or examination findings.

Rationale

Ultrasound has been compared with physical examination findings, suggesting physical exam identified fewer abnormalities compared with ultrasound, though there was not clinical correlation with treatment outcomes (Kim et al., 2007). Ultrasound utilized to evaluate asymptomatic shoulders found increased prevalence of full-thickness tears with increased age (Sher et al., 1995, Tempelhof et al., 1999), with approximately 6% among 212 individuals (Schibany et al., 2004) and in 7.6% of 420 patients (Moosmayer et al., 2009). Asymptomatic tears increase in prevalence by age – 50 to 59 (2.1%) versus 60 to 69 (5.7%) versus 70 to 79 (15%) (Moosmayer et al., 2009).

Ultrasound is thought to be relatively effective for identifying full-thickness tears (Middleton et al., 1986, Furtschegger et al., 1988, Mack et al., 1988, Mack et al., 1988, Brenneke et al., 1992, Iannotti et al., 1996, Zehetgruber et al., 2002, Ottenheijm et al., 2010, Smith et al., 2011); however, it appears somewhat less effective for identifying partial-thickness tears (Brenneke et al., 1992, Naredo et al., 1999, Ottenheijm et al., 2010, Smith et al., 2011). A surgical case series of 42 patients attempted to determine the diagnostic accuracy of ultrasound. Ultrasound detected all full-thickness tears (100% sensitive, 97% specific), but only 6 of 13 of the partial-thickness tears (46% sensitive, 97% specific). One full-thickness tear was falsely diagnosed. Another study has suggested sensitivity for detection of tear size of 83 to 86%. (Ianotti) Ultrasound has advantages of being able to move the arm actively or passively during the examination; it is less expensive; and it may be available in most centers. (Boykin, Friedman et al.) When conservative treatment failed, skilled physician's usingultrasound reportedly had high diagnostic accuracy identifying tendinopathy, calcifying tendonitis, and partial- and full-thickness tears. (Moosikasuwan, Miller et al. , Ottenheijm, Jansen et al.) SLAP lesions cannot be well visualized using ultrasound. (Hanchard, Lenza et al.) Impingement was felt to have been diagnosed in 27 of 34 cases (79% sensitive, 96% positive predictive value). (Read and Perko) A small study of ultrasound the day before surgery for shoulder arthritis in 20 patients suggested that ultrasound was accurate for evaluating hypertrophy of the bursa (93% sensitive, 83% specific), biceps tendon rupture (70% sensitive, 100% specific) and rotator cuff tear (83% sensitive, 57% specific). (Alasaarela, Leppilahti et al.) Ultrasound-guided MR arthrography was evaluated in an RCT with anterior versus posterior approaches and found equal ratings of discomfort. (Koivikko and Mustonen) Ultrasound is not invasive, is of low to moderate cost, and has little risk of adverse effects; therefore, although there are concerns that MRI may be superior for imaging most of shoulder soft tissue, ultrasound is recommended particularly for evaluation of rotator cuff tears as a complication of shoulder fracture(s). The main disadvantage is the high dependency on the physician's skills. (Boykin, Friedman et al. , Hanchard, Lenza et al.)

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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14.4.8. SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT) FOR SHOULDER OR CLAVICULAR FRACTURES

Not Recommended

Single-proton emission computed tomography (SPECT) is not recommended for the evaluation of patients with shoulder or clavicular fractures.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain. One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning. Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment, and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating shoulder disorders.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial,

controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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14.4.9. POSITRON EMISSION TOMOGRAPHY (PET)

POSITRON EMISSION TOMOGRAPHY (PET) FOR SHOULDER OR CLAVICULAR FRACTURES

Not Recommended

Positron emission tomography (PET) is not recommended for the evaluation of patients with shoulder or clavicular fractures.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain. One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning. Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating shoulder disorders.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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14.5. TREATMENT RECOMMENDATIONS

14.5.1. INITIAL CARE

Initial care of a patient with fracture generally involves preclusion of use, prompt assessment of the severity, a determination of whether surgery or non-operative management is best, and education. Identification of accompanying disorders, such as rotator cuff tear, allows for treatment of a second condition to substantially reduce or resolve the symptoms. Over-the-counter analgesics, self-applications of heat and ice, and slings and immobilizers have been used to treat non-displaced fractures and manage pain.

OVER-THE-COUNTER (OTC) ANALGESICS FOR TREATMENT OF SHOULDER OR CLAVICULAR FRACTURES

Recommended

Over-the-counter analgesics are recommended for treatment of shoulder or clavicular fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Shoulder fractures, usually as adjuncts to other treatments

Benefits

Self-management of the pain

Harms

Negligible for OTC analgesics unless acetaminophen doses exceed 3.5 g, or the patient has liver disease or other contraindications

Frequency/Dose/Duration

Analgesics should be used per manufacturer's recommendations

Indications for Discontinuation

Fracture healing, resolution of pain, lack of efficacy, intolerance, complication

Rationale

There are no quality trials evaluating analgesics for managing shoulder fractures. There is some evidence of delayed fracture healing with NSAIDs. However, analgesics and OTC NSAIDs are likely helpful and there is some quality evidence for the use of prescription NSAIDs for other shoulder nociceptive pain (see NSAIDs for rotator cuff tendinopathy). Thus, they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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SELF-APPLICATION OF HEAT OR ICE FOR TREATMENT OF SHOULDER OR CLAVICULAR FRACTURES

Recommended

Self-application of heat or ice is recommended for treatment of shoulder or clavicular fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Shoulder fractures, usually as adjuncts to other treatments

Benefits

Self-management of the pain

Harms

Possible cold injuries or burns

Frequency/Dose/Duration

Self-applications of ice or heat are typically 3-5 times/day. Ice is more typically used in the acute phase for fractures.

Indications for Discontinuation

Fracture healing, resolution of pain, lack of efficacy, intolerance, complication

Rationale

There are no quality trials evaluating ice or heat for managing shoulder fractures. However, they may be helpful, have generally negligible adverse effects, are of negligible cost, and thus they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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14.5.2. MEDICATIONS

Over-the-counter medications may be helpful to manage pain. These especially include acetaminophen and NSAIDs (646,645), with NSAIDs showing greater efficacy, but overall acetaminophen has a generally greater safety profile. Generally, the only medications commonly used for fracture patients are NSAIDs and brief, post-operative use of opioids in select patients. Other medications may be indicated if there is osteopenia.

14.5.3. DEVICES

Slings, braces, and immobilizers are used in the acute and post-operative treatment phases to facilitate fracture healing. They are then weaned off, as they naturally promote debility and predispose towards adhesive capsulitis.

SLINGS, BRACES, AND IMMOBILIZERS FOR TREATMENT OF SHOULDER FRACTURES

Recommended

Slings, braces, and immobilizers are not recommended for the treatment of shoulder fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Acute shoulder fractures. Also used in the perioperative timeframe. Should be weaned off when able, with institution of range-of-motion exercises at the earliest clinically-indicated opportunity.

Benefits

Facilitate fracture and operative healing

Harms

Promotes debility and adhesive capsulitis

Indications for Discontinuation

Must be determined by the orthopedist or other treating physician with respect to fracture healing and/or operative fixation

Rationale

One RCT suggested there was no difference between 1 and 3 weeks of immobilization for nonoperatively treated proximal humeral fractures (Martinez, 2021). There are no other quality trials evaluating slings, braces and immobilizers for managing shoulder fractures. However, slings, braces, and immobilizers are indicated for shoulder fractures with any instability and/or need to immobilize while fracture callous formation or operative healing is underway and minimization of movement is clinically required.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Of the 29 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MAGNETS FOR TREATMENT OF SHOULDER FRACTURES

Not Recommended

Magnets and magnetic stimulation are not recommended for treatment of shoulder fractures.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

Magnets and magnetic stimulation have been evaluated in quality trials for other musculoskeletal disorders and were found to be ineffective. Thus, they are not recommended for treatment of shoulder fractures.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized

controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TAPING FOR TREATMENT OF SHOULDER FRACTURES

Not Recommended

Taping is not recommended for treatment of shoulder fractures.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence High

Rationale

Taping has been evaluated in quality trials for other musculoskeletal disorders and was found to be ineffective. Thus, it is not recommended for treatment of shoulder fractures.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

OTHER MODALITIES FOR TREATMENT OF SHOULDER FRACTURES

No Recommendation

There is no recommendation for or against the use of diathermy, infrared therapy, laser therapy, high-voltage galvanic, H-wave stimulation, iontophoresis, microcurrent, percutaneous electrical nerve stimulation (PENS), sympathetic electrotherapy, interferential therapy, or transcutaneous electrical stimulation (TENS) for the treatment of shoulder fractures.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of these treatments for these shoulder fracture patients; thus, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

14.5.4. ALLIED HEALTH INTERVENTIONS

ACUPUNCTURE FOR TREATMENT OF SHOULDER FRACTURES

No Recommendation

There is no recommendation for or against acupuncture to treat shoulder fractures.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials of acupuncture for treatment of shoulder fractures and thus there is no recommendation for or against acupuncture.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANUAL THERAPY FOR TREATMENT OF SHOULDER FRACTURES

No Recommendation

There is no recommendation for or against the use of manual therapy for shoulder fractures.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of manual therapy for shoulder fracture patients. Thus, there is no recommendation for or against its use.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANIPULATION OR MOBILIZATION FOR TREATMENT OF SHOULDER FRACTURES

No Recommendation

There is no recommendation for or against the use of mobilization or manipulation for shoulder fractures.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of these treatments for shoulder fracture patients; thus, there is no recommendation for or against their use.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search,

and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MASSAGE FOR TREATMENT OF SHOULDER FRACTURES

No Recommendation

There is no recommendation for or against the use of massage for shoulder fractures.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials demonstrating efficacy of massage for shoulder fracture patients; thus, there is no recommendation for or against its use.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

LOW-INTENSITY PULSED ULTRASOUND FOR TREATMENT OF FRACTURES

Not Recommended

Low-intensity pulsed ultrasound is not recommended for treatment of Type I (mid-shaft) clavicular fractures.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

While there is no quality evidence regarding shoulder fractures, there is one high-quality RCT for clavicular fractures showing lack of efficacy to accelerate healing (Lubbert et al., 2008). Thus, by inference, ultrasound is also not indicated for treatment of shoulder fractures.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

14.5.5. INJECTION THERAPIES

Steroid, viscosupplementation, platelet-rich plasma, and prolotherapy injections are generally not indicated for shoulder fractures. There may be other indications.

14.5.6. SURGICAL CONSIDERATIONS

NONOPERATIVE TREATMENT FOR SHOULDER FRACTURES

Recommended

Nonoperative treatment for shoulder fractures is recommended for most patients with nondisplaced or minimally displaced fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Non- or minimally displaced fractures. Also, based on numerous factors assessed and evaluated in aggregate by the orthopedic surgeon, including surgeon's preferences and experiences, open

fractures, multiple-part fractures, associated vascular injuries, polytrauma, age, bone quality, status of the rotator cuff, hand dominance, smoking status, preexisting pathology, medical comorbidities, bilateral humeral fractures, radial nerve palsy after manipulation, neurological loss after penetrating injuries, and unacceptable alignment (Bell et al., 1985, Brumback et al., 1986, Robinson et al., 1993, Changulani et al., 2007, Drosdowech et al., 2008).

Benefits

Faster recovery without surgery if able to be treated non-operatively.

Harms

Negligible provided there is sufficient alignment and approximation to result in healing.

Rationale

Fracture classification systems have been developed for these fractures (Kocher, 1896, Codman, 1990, Neer, 1960, Hertel, 1996, Mora Guix et al., 2009), although interrater reliability is low and their impact on management remains unclear (Sidor et al., 1993, Siebenrock et al., 1993, Brien et al., 1995). For proximal humeral fractures, there are few quality trials comparing operative treatment with non-operative treatment or comparing various operative treatments and approaches. Two moderate-quality trials have compared operative with non-operative treatments in fairly narrow indications; thus, the value of these trials is sharply limited in their ability to address the operative vs. non-operative indications for the broad group of proximal humeral fracture patients (Kristiansen et al., 1988, Zyto et al., 1997). One moderate-quality trial evaluating 3 or 4-part displaced proximal humeral fractures in the elderly failed to find superiority of the operative approach (Zyto et al., 1997). The second trial found an external fixator, although not commonly used, was superior to a sling to manage displaced proximal humeral fractures that had been reduced (Kristiansen et al., 1988).

Surgical indications are numerous, but most proximal humeral fractures are treated non-operatively with good results (Neer, 1970, Neer, 1968, Balfour et al., 1982, Mills et al., 1985). Thus, non-operative treatment is recommended for many of these fractures.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Of the 29 articles considered for inclusion, 5 randomized trails and 0 systematic reviews met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We

considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SURGICAL TREATMENT FOR SHOULDER FRACTURES

Sometimes Recommended

Surgical intervention for shoulder fractures is recommended for select patients with displaced fractures. Arthroplasty, most commonly hemiarthroplasty, is recommended for select patients with displaced proximal humeral fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Based on numerous factors assessed and evaluated in aggregate by the orthopedic surgeon, including (but not limited to) the surgeon's preferences and experiences, open fractures, multiple-part fractures, associated vascular injuries, polytrauma, age, bone quality, status of the rotator cuff, hand dominance, smoking status, preexisting pathology, medical comorbidities, bilateral humeral fractures, radial nerve palsy after manipulation, neurological loss after penetrating injuries, and unacceptable alignment (Bell et al., 1985, Brumback et al., 1986, Robinson et al., 1993, Changulani et al., 2007, Drosdowech et al., 2008).

Benefits

Superior recovery

Harms

Operative complications including hardware-related, osteonecrosis, and infection. For arthroplasty, potential for worse results compared with less major surgical treatment.

Rationale

Though proximal humeral fractures have a relatively high incidence, the great variability in the fractures themselves and number of viable options for surgical treatment leads to difficulty comparing treatment modalities. One RCT suggested comparable results at 2 years when comparing surgical and nonsurgical treatment of displaced proximal humeral fractures (Handoll et al., 2015, Rangan et al., 2015, Handoll et al., 2017, Norman et al., 2020). The lack of quality literature comparing options has been widely noted and confirmed by systematic reviews (Misra et al., 2001, Handoll et al., 2003, Bhandari et al., 2004, Lanting et al., 2008, Brorson et al., 2009, Handoll et al., 2015, Nijs et al., 2009).

Operative procedures include conventional, angular stable, and locked plates (Brunner et al., 2009,

Szyszkowitz et al., 1993, Sturzenegger et al., 1982, Drosdowech et al., 2008, Misra et al., 2001, Lin, 2006, Sehr et al., 1988, Plecko et al., 2005, Moda et al., 1990, Fankhauser et al., 2005, Esser, 1994, Rouleau et al., 2009, Ziegler et al., 2019, Chen et al., 2019, Rouleau et al., 2020, Sohn et al., 2017, Sudkamp et al., 2009), external fixators (Kristiansen et al., 1987, Kristiansen et al., 1989, Karatosun et al., 2002), partial or hemiarthroplasty (Szyszkowitz et al., 1993, Jones et al., 1987, Neer, 1970, Brorson et al., 2009, Nijs et al., 2009, Neer, 1968, Mighell et al., 2003, Kay et al., 1988, Kontakis et al., 2008, Kontakis et al., 2008, Moeckel et al., 1992, Bosch et al., 1998, Green et al., 1993, Movin et al., 1998, Zyto et al., 1995, Zyto et al., 1998, Robinson et al., 2008, Rietveld et al., 1988, Kraulis et al., 1976, Boileau et al., 2001, Demirhan et al., 2003, Dimakopoulos et al., 1997, Paavolainen et al., 1983, Tanner et al., 1983, Stableforth, 1984, Goldman et al., 1995, Prakash et al., 2002, Skutek et al., 1998, Wretenberg et al., 1997, Schlegel, 1997), reverse arthroplasty (Kontakis et al., 2008, Matsen et al., 2007, Rockwood, 2007, Martin et al., 2008), screws and cannulated screws (Sturzenegger et al., 1982, Zingg et al., 2002, Bungaro et al., 1998, Chen et al., 1998), nails (Lee et al., 1981, Young et al., 2008, Rodriguez-Merchan, 1995, Benegas et al., 2014, Gracitelli et al., 2016), compression plates (Rodriguez-Merchan, 1995), cerclage wire (Lee et al., 1981, Szyszkowitz et al., 1993), Kirschner wires (Jakob et al., 1991, Bungaro et al., 1998, Darder et al., 1993), use of intramedullary bone cement (Matsuda et al., 1999), and a combination tension band technique (Darder et al., 1993, Wijgman et al., 2002, Kristiansen et al., 1989, Zyto et al., 1997). Pins are usually removed in 3 to 6 weeks. Robotic approaches have been used (Kröger et al., 2021).

Despite a plethora of techniques, quality comparative trials are nearly completely lacking (Lanting et al., 2008). Conclusions for younger populations and high-physical demand patients are lacking quality evidence. Additionally, the variability of the types of fractures provides additional uncertainty regarding optimal intervention(s). Glenohumeral joint lavage has been shown to not be of benefit (Biermann et al., 2020). Thus, there is no recommendation for or against the use of a specific product; however surgical treatment of complex or displaced fractures is recommended.

For proximal humeral fractures, there are no quality trials comparing arthroplasty and hemi-arthroplasty with other surgical approaches to ascertain whether these approaches are superior. Clinical results suggest these are successful treatments, and thus they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Of the 29 articles considered for inclusion, 14 randomized trails and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ARTHROPLASTY FOR SHOULDER FRACTURES

Sometimes Recommended

Arthroplasty, most commonly hemiarthroplasty, is recommended for select patients with displaced proximal humeral fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Select patients with displaced proximal humeral fractures.

Benefits

Superior results compared with other approaches

Harms

Operative complications including hardware-related, osteonecrosis, and infection. Potential for worse results compared with less major surgeries.

Indications for Discontinuation

Not specified.

Rationale

For proximal humeral fractures, there are no quality trials comparing arthroplasty and hemi-arthroplasty with other surgical approaches to ascertain whether these approaches are superior. Clinical results suggest these are successful treatments, and thus they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms.

Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

REVERSE ARTHROPLASTY FOR SHOULDER FRACTURES

Sometimes Recommended

Reverse shoulder arthroplasty is recommended for select patients with displaced proximal humeral fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Select patients with displaced proximal humeral fractures.

Benefits

Superior results compared with other approaches

Harms

Operative complications including hardware-related, osteonecrosis, and infection. Potential for worse results compared with less major surgeries.

Rationale

For select patients with proximal humerus fractures, reverse total shoulder arthroplasty is recommended over hemiarthroplasty or plate fixation. One multicenter RCT demonstrated improved outcomes in elderly patients treated with RTSA as compared to ORIF for intra-capsular proximal humerus fractures (Fraser, 2020). There have been three RCT comparing RTSA to hemiarthroplasty that suggest improved patient outcome scores, better overall range of motion, and lower reoperation rate with RTSA (Sebastia-Forcada, 2014, Jonsson, 2021, Laas, 2021). Systematic reviews and meta-analyses also suggest more favorable clinical outcomes in patients treated with RTSA as compared to hemiarthroplasty (Pizzo, 2021, Austin, 2019, Shukla, 2016).

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized

controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

14.5.7. REHABILITATION PROGRAMS

Therapy including education and exercise is thought to be particularly important, especially for more severely affected patients, those with complications, the elderly, or those with comorbidities (909,910,911). There are variable durations of immobilization prior to exercise that have been used to treat non-operatively treated impacted proximal humeral fractures (912,913,914,915,909,916,917,918). Slings have been utilized, especially for the first 1 to 3 weeks of treatment (919,920,921,922). Early ROM has been advocated (917,923,924).

EARLY MOBILIZATION FOR SHOULDER FRACTURES

Recommended

Early mobilization is strongly recommended for most stable shoulder fractures, including proximal humeral fractures.
Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

Indications

Most patients with stable shoulder fractures, including proximal humeral fractures (Hodgson et al., 2003, Hodgson et al., 2007, Lefevre-Colau et al., 2007, Agorastides et al., 2007, Kristiansen et al., 1989).

Benefits

Earlier and improved return to function

Harms

Theoretical aggravation of a fracture if begun before sufficiently healed.

Frequency/Dose/Duration

The goal is to begin range of motion as early as possible to help prevent stiffness. Frequent follow-up may help to transition the patient from immobilization to motion. Begin range of motion once fracture is stable- very early for stable impacted fractures. Other fractures can wait until the proximal humerus moves as if it is one unit- up to four weeks for most fractures. Treating orthopedist must ascertain

whether early mobilization is appropriate. Considerations include patient age, fracture type, post-reduction or post-surgical results, comorbidities. Early mobilization generally starts within 1 week.

Rationale

Four high- and moderate-quality trials have evaluated early mobilization in patients with various types of proximal humeral fractures. All quality trials either show superiority or equivalency of early mobilization. A high-quality trial of impacted proximal fractures treated non-operatively suggested early mobilization is superior (Lefevre-Colau et al., 2007). An early mobilization program for minimally displaced two-part non-operatively managed proximal humeral fractures was compared with delayed with the beginning within 1 week (Hodgson et al., 2003, Hodgson et al., 2007). A moderate-quality study of an early mobilization program for fractures that were reduced found less pain and better function with earlier mobilization (Kristiansen et al., 1989). An additional trial in post-operative patients also suggested early mobilization was superior (Agorastides et al., 2007). Treating orthopedist must ascertain whether early mobilization is appropriate. Early mobilization is cost effective; therefore, it is recommended for most patients.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Of the 29 articles considered for inclusion, 8 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EDUCATION AND EXERCISES FOR SHOULDER FRACTURES

Recommended

Education and exercise are strongly recommended for most shoulder fractures, including proximal humeral and/or scapular fracture patients.
Strength of evidence Strongly Recommended, Evidence (A)
Level of confidence High

Indications

Most patients with shoulder fractures, including proximal humeral fractures

Benefits

Improved compliance with the rehabilitation program and faster return of function

Harms

Negligible

Frequency/Dose/Duration

Education may include adaptive techniques and use of adaptive equipment (as indicated) to facilitate continued participation in daily activities despite limitations of shoulder

Rationale

Four high- and moderate-quality trials have evaluated early mobilization in patients with various types of proximal humeral fractures. All quality trials either show superiority or equivalency of early mobilization. A high-quality trial of impacted proximal fractures treated non-operatively suggested early mobilization is superior (Lefevre-Colau et al., 2007). An early mobilization program for minimally displaced 2-part non-operatively managed proximal humeral fractures was compared with delayed with the beginning within 1 week (Hodgson et al., 2003, Hodgson et al., 2007). A moderate-quality study of an early mobilization program for fractures that were reduced found less pain and better function with earlier mobilization (Kristiansen et al., 1989). An additional trial in post-operative patients also suggested early mobilization was superior (Agorastides et al., 2007). Treating orthopedist must ascertain whether early mobilization is appropriate. One trial suggested task-oriented exercises improved disability compared to general physical therapy over a one-year timeline (Monticone et al., 2021). Education and exercises are not invasive, appear to have few adverse effects, and are likely cost effective; therefore, they are recommended for most patients.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Of the 29 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SELF-TRAINING FOR SHOULDER FRACTURES

Sometimes Recommended

Self-training exercise is moderately recommended for select shoulder fractures, incuding patients with proximal humeral fractures.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence High

Indications

Patients with shoulder fractures including proximal humeral fractures who are motivated and compliant with exercises (Lungberg et al., 1979, Bertoft et al., 1984, Revay et al., 1992).

Benefits

Improved results from the rehabilitation program and faster return of function.

Harms

Negligible

Rationale

Three moderate-quality trials have documented self-training is equivalent to supervised training (Lungberg et al., 1979, Bertoft et al., 1984, Revay et al., 1992). Considerations include patient age, fracture type, post-reduction or post-surgical results, comorbidities. Self-training is not invasive, has few adverse effects, and is low to moderate cost; thus, it is recommended for most proximal humeral fracture patients.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

14.5.8. FOLLOW-UP VISITS

Patients with fractures generally require several follow-up appointments for purposes of monitoring symptoms, advancing treatment, advancing activities, and gradually reducing limitations. The number

of follow-up appointments is higher when surgery is needed, the type of surgery and post-operative treatment care (e.g., AAOS guideline), patient-specific factors and/or there are needs to treat a co-existent condition. Frequencies of appointments may also be greater if workplace limitations are required, job demands are higher, or where job modifications or adaptive equipment are required. . Frequencies may also be higher based on employer and insurer requests or needs. Post-operative rehabilitation can be considerable, particularly in older patients with other associated injuries such as rotator cuff injuries. In those cases, there may be a requirement for therapy on a prolonged basis to recover as much function as possible.

15. CLAVICULAR FRACTURES

15.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing clavicular fractures from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

15.2. OVERVIEW

Fractures of the clavicle are among the most common fractures of the shoulder, constituting an estimated 35 to 66% (925,926,927,928,929,930). They particularly occur among children and young adults, and are typically related to lateral falls on the shoulder, falls on an outstretched arm, sporting injuries, vehicular crashes, and other accidents (931,932). Most fractures involve the middle third of the clavicle (905,925,926,931,933,934,935). A "floating shoulder" is a term used to describe ipsilateral fractures of the clavicular shaft and the scapular neck (936,937,938,939,940,941,942,943,944).

15.3. WORK LIMITATIONS

Shoulder fractures generally require work limitations. For simple clavicular fractures, limitations typically include minimizing use of the affected extremity and gradually allow increased use as healing occurs. In contrast with the acute phase of managing humeral fractures, patients with clavicular fractures generally wear a brace and are allowed unrestricted light use, keyboarding, paperwork and other tasks involving under 5 pounds of force (push, pull, lift).

15.4. DIAGNOSTIC RECOMMENDATIONS

15.4.1. X-RAYS

X-RAYS FOR SHOULDER OR CLAVICULAR FRACTURES

Recommended

X-rays are recommended for evaluation of shoulder or clavicular fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

All patients suspected of having shoulder or clavicular fractures, as well as those with trauma without suspicion of fracture to help rule out fracture. Scapular views are required to evaluate scapular fractures.

Benefits

Diagnosis of a fracture, calcific tendinitis, or otherwise latent medical condition(s).

Harms

Medicalization or worsening of otherwise benign shoulder condition; minor radiation exposure.

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient with two to three views. After initially negative x-rays, a second set of x-rays 7-14 days after trauma is advisable if there is either a suspicion of fracture or lack of major interval improvements. For patients with chronic shoulder pain, it may be reasonable to obtain another set of x-rays later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

X-rays are helpful to evaluate for fracture. They also assist in differential diagnostic possibilities such as tendinosis, calcific tendinitis, and arthroses, which result in different treatment options. X-rays are non-invasive, low to moderate costly, and have little risk of adverse effects, and therefore are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures,

clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

15.4.2. COMPUTED TOMOGRAPHY

Computerized tomography remains an important imaging procedure, particularly for bony anatomy, whereas MRI is superior for soft tissue abnormalities. However, most patients have issues with soft tissue rather than bony abnormalities in the shoulder; thus, on a population-basis, far fewer CT scans are ordered. CT may nevertheless be useful for shoulder joint abnormalities where advanced imaging of the bones is required (i.e., complex proximal humerus fracture, scapular fracture). CT also may be useful to evaluate the anatomy in patients with contraindications for MRI (most typically an implanted metallic-ferrous device). CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – glenoid deficiency and humeral Hill-Sachs – as MRI is not as good for bone imaging. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear.

COMPUTED TOMOGRAPHY FOR EVALUATION OF CLAVICLE FRACTURES

Not Recommended

Computerized tomography is rarely needed for isolated clavicular fractures. It is selectively recommended for the evaluation of complex proximal humeral and glenoid/scapular fractures.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Generally not indicated for clavicular fractures. Imaging may be indicated for complex proximal humeral and glenoid/scapular fractures or other calcified structures. For most shoulder fractures, x-rays suffice. CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – glenoid deficiency and humeral Hill-Sachs – as MRI is not as good for bone imaging.

Benefits

Diagnosis and understanding of the degree of complex fractures, calcific tendinitis.

Harms

Radiation exposure.

Frequency/Dose/Duration

Obtaining a CT once is generally sufficient. For patients with chronic shoulder pain, it may be reasonable to obtain a second CT later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

X-rays are sufficient for most clavicular fractures. CT Is superior where imaging calcified structures is required, such as for complex proximal humeral and glenoid/scapular fractures. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear. MRI is considered superior to computerized tomography for imaging most shoulder abnormalities where advanced imaging of soft tissues is usually the primary concern. A contrast CT study is minimally invasive, has few, if any, adverse effects but is costly. It is recommended for select use.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

15.4.3. DIAGNOSTIC ANESTHETIC INJECTIONS

Diagnostic injections are not needed for patients with simple clavicular fractures. Diagnostic injections particularly of the subacromial space, glenohumeral joint and acromioclavicular joint are sometimes performed. However, they are nearly always performed in combination with a therapeutic intervention, such as a glucocorticosteroid injection. Injection with a therapeutic agent is nearly always preferable due to less overall invasiveness with 1 injection rather than 2, as well as the potential to assess the patient both immediately post-injection for diagnostic purposes as well as longer term for therapeutic purposes. See Rotator Cuff Tendinopathy Injections.

15.4.4. MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for many shoulder joint problems because it tends to be helpful for imaging soft tissues, particularly the rotator cuff.

MAGNETIC RESONANCE IMAGING FOR SHOULDER OR CLAVICULAR FRACTURES

Sometimes Recommended

MRI is selectively recommended for patients with shoulder or clavicular fractures who are also suspected of having acute, clinically significant rotator cuff tears. It is also recommended for select patients with subacute or chronic shoulder pain thought to potentially have a symptomatic rotator cuff tear.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Patients with shoulder fractures who are also thought to have an acute, clinically significant rotator cuff tear or subacute or chronic shoulder pain suspected of having a rotator cuff tear. If there is significant rotator cuff weakness, immediate imaging may be indicated. MRI may be indicated as well for scapular fractures with concerns about thoracic injury. Exceptions include elderly patients, those who would not undergo surgical repair, or those who have substantial signs of pre-existing large/massive rotator cuff tear. It is also reasonable to wait for 1 or 2 weeks to ascertain whether the condition is likely to resolve with conservative care without obtaining an MRI. Most acute tears without significant weakness should wait 2+ weeks prior to imaging as some patients with acute pain and limited ROM resolve clinically. Those with subacute or chronic pain should generally have failed additional non-operative treatment including NSAID, exercise after fracture healing and injection(s).

Benefits

Secure a secondary diagnosis.

Harms

False positives and false negatives for rotator cuff tears.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

One moderate-quality study compared MRI with arthrography, suggesting MRI is superior to arthrography to evaluate for rotator cuff tears (Blanchard et al., 1999); however, arthrography alone has been largely replaced by other procedures. Otherwise, MRI has not been evaluated in high-quality studies for shoulder joint pathology (Dinnes et al., 2003, Leunig et al., 2004, Kassarjian et al., 2005). MRI appears particularly helpful for soft tissue abnormalities and has been suggested for evaluations of patients with symptoms over 3 months (Bredella et al., 2005, Kassarjian et al., 2005). MRI was compared with arthroscopy in 57 patients with shoulder pain of unclear cause (Torstensen et al., 1999). MRI was found to be accurate in detecting 68% of rotator cuff tears and 62% accurate in detecting labral injuries. MRI sensitivity for RC tears was 96% and specificity 49% (for labral tears, 73% sensitive, 58% specific). The authors concluded that “MRI does not appear to be an accurate effective tool for assessing shoulder pathologic conditions in patients in whom the clinical picture is not clear and therefore may not be of assistance in surgical planning for patients with these difficult conditions.”

MRI was compared with arthroscopic findings among 16 patients with trauma (Kirkley et al., 2003). The authors found moderate correlation for superior labral lesions (k = 0.60), fair agreement for rotator cuff tear (k = 0.355), Hill-Sachs (k = 1.0), and moderate for size (k = 0.44). A consecutive case series of 104 patients with shoulder problems were evaluated and randomized to MRI first versus arthrography first. There were modestly fewer changes in diagnostic categories with MRI (30%) than arthrography (37%), p >0.5. MRI led to slightly more changes in planned therapy (36% vs. 25%, p >0.3). MRI was found to be 79% accurate, 81% sensitive and 78% specific for full-thickness rotator cuff tears. Arthrography was found to be 82% accurate, 50% sensitive and 96% specific (Blanchard et al., 1999). A cross-sectional comparison of MRI (1.5T loop-gap resonator surface coil), double-contrast arthrography, high-resolution sonography, and surgery among 38 patients with suspected rotator cuff tears did not include all patients receiving all tests or surgery (other than MRI and arthrography) and reported a sensitivity of MRI of 100% (Burkhead WZ, 2007). Ultrasound detected 9/15 (60%) of tears. However, the study population was small and biased in favor of overestimating the tests' sensitivity.
MRI has shown increased changes in the rotator cuff and tears with increased age (Sher et al., 1995, Needell et al., 1996), as well as a high prevalence of bony and peritendinous shoulder abnormalities among those without symptoms (Needell et al., 1996). MRI has reasonably good operant characteristics for full-thickness tears, although it does not have good sensitivity for partial thickness tears (Dinnes et al., 2003). Fatty infiltration of the rotator cuff tendons is also found on MRI and thought to signify chronicity as well as portending a poorer surgical outcome (Berhouet et al., 2009). A comparative assessment of T-2 weighted fast spin-echo technique with vs. without fat-suppression MRI for assessment of rotator cuff tears among 177 patients thought to have tears found no differences in assessments of complete tears, but differed in interpretations of partial tears (Singson et al., 1996). Compared with surgery, sensitivity was 100% for full-thickness tears and specificity for intact tendons was 86%. Fat suppression was felt helpful for partial tears. MRI demonstrates acromial abnormalities and there is a higher prevalence of Type 3 acromion processes among those with either rotator cuff tear or impingement syndrome (Epstein et al., 1993). It has been suggested increased T2 signal in the distal clavicle may be an indication for surgical resection.

MRIs are considered the gold standard for evaluation of osteonecrosis patients and are used to quantify volume of affected tissue including marrow edema which is inversely correlated with prognosis (Coombs et al., 1994, Koo et al., 1995, Scheiber et al., 1999, Cherian et al., 2003, Radke et al., 2003, Jones et al., 2004, Harreld et al., 2009).

Magnetic resonance imaging (MRI) is often used as a secondary test after x-ray for many shoulder joint problems since it tends to be helpful for imaging soft tissues, particularly the rotator cuff (Cartland et al., 1992, Tirman et al., 1994, Wnorowski et al., 1997, Connell et al., 1999, Tuite et al., 2000, Tung et al., 2000, Ardic et al., 2006, Chang et al., 2006, Reuss et al., 2006, Chang et al., 2008, Pandya et al., 2008, McFarland et al., 2009, Mulyadi et al., 2009). Although studies are not heterogeneous, pooled estimates of the sensitivity for full-thickness tears has been calculated and is 89% with specificity 93%, while for partial thickness tears, these estimates are only 44% sensitivity and 90% specificity (Dinnes et al., 2003). Similarly accuracy is lower for smaller than larger tears (Yamakawa et al., 2001). There are concerns that MRI is inferior to MR arthrography for evaluating the labrum (Schmerl et al., 2005); thus, MRA is recommended for evaluation of the joint.

MRI is not invasive, has potential adverse effects from issues of claustrophobia or complications of medication, but is costly. MRI is not recommended for routine shoulder imaging and is not indicated solely to evaluate fractures, especially because CT is superior for osseous imaging. However, it is

recommended for select shoulder joint pathology particularly involving concerns regarding secondary soft tissue pathology.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Of the 29 articles considered for inclusion, 1 diagnostic study and 0 systematic reviews met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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15.4.5. MAGNETIC RESONANCE ARTHROGRAM

Magnetic resonance arthrography (MRA) combines and MRI with an arthrogram to overcome MRI limitations and is usually performed in preference to CT arthrography unless bony structure definition is needed as well. MRA is particularly thought to be effective for imaging labral pathology.

MAGNETIC RESONANCE ARTHROGRAM FOR DIAGNOSING SHOULDER OR CLAVICULAR FRACTURES

Sometimes Recommended

Magnetic resonance arthrography (MRA) is selectively recommended for diagnosing labral tears in patients with shoulder or clavicular fracture(s).
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Patients with shoulder fracture(s) who also have symptoms of, or clinical suspicion of labral tears. Patients should generally have failed non-operative treatment of the labral tear or soft tissue including NSAID and waiting 4 to 6 weeks without trending towards resolution.

Benefits

Secure a diagnosis.

Harms

False positives and false negatives for labral tears. Arthrography improves the accuracy especially regarding complete rotator cuff tears and significant labral tears. Small risk of infection and complications from the injection.

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

MRA has not been evaluated in quality studies among patients with shoulder fracture(s). Although studies are heterogeneous, pooled estimates of the sensitivity for full-thickness tears is estimated at 95% with specificity 93% (Dinnes et al., 2003). There is high prevalence for labral injury with first shoulder dislocation based on MRA (Antonio et al., 2007). Arthrography with low-field MR was found to be equivalent to high-field in a series of 38 patients (Loew et al., 2000). A comparison of high- versus low-field MR imaging for SLAP tears among symptomatic patients found high field superior for diagnosing SLAP (Tung et al., 2000). The sensitivity of high field MRA was 90% and specificity was 63%, while sensitivity for low field was 64% and 70% specificity. MRA was found superior to CT arthrography (CTA) and marginally better than MRI for identification of labral tears in a case series of patients with recurrent anterior instability, prior anterior dislocation, or shoulder pain of unknown cause (Chandnani et al., 1993). MRA sensitivity for a labral tear was 96.4%, MRI was 92.9%, and CTA was 73.1%. Specificity was 100% for all three tests; however, this appears overstated as there were only two patients without a tear in this small case series.

MR arthrography is invasive, has adverse effects (including a low but definite risk of infection), and is painful. It is also costly, although MRA is believed to provide better cost effectiveness than MRI or CT arthrography for select diagnoses (Oh et al., 1999). It is likely the best imaging procedure available for patients thought to have labral tears or patients with good strength in order to assess the labrum and rotator cuff with traumatic injury simultaneously, and is recommended for select use.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures,

clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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15.4.6. ULTRASOUND

Diagnostic ultrasound has been used for evaluating rotator cuff tears.

ULTRASOUND FOR DIAGNOSING SHOULDER OR CLAVICULAR FRACTURES

Sometimes Recommended

Ultrasound is selectively recommended for shoulder or clavicular fracture patients also suspected of having rotator cuff tears, tendinoses, or impingement.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Ultrasound technicians should have sufficient skill to obviate the need for scanning (Boykin et al., 2010, Hanchard et al., 2013); otherwise, the test introduces unnecessary redundancy. Patients with shoulder fracture(s) who also have symptoms and signs of a clinically significant rotator cuff tear, tendinosis, or impingement (Naredo et al., 1999, Iannotti et al., 2005, Ardic et al., 2006, Wall et al., 2012). Most clinical presentations should wait approximately 2 weeks prior to imaging as some patients with acute pain and limited range of motion resolve clinically; obvious tears are an exception to waiting two weeks. Those with subacute or chronic pain should generally have failed additional non-operative treatment including NSAID, exercise, and injection(s) (Moosikasuwan et al., 2005, Ottenheijm et al., 2010). A MR arthrogram is recommended for suspected labral injury (see below) (Ardic et al., 2006).

Benefits

Secure a diagnosis.

Harms

False positives and false negatives.

Frequency/Dose/Duration

Repeat ultrasound should be based on significant change in symptoms and/or examination findings.

Rationale

Ultrasound has been compared with physical examination findings, suggesting physical exam identified fewer abnormalities compared with ultrasound, though there was not clinical correlation with treatment outcomes (Kim et al., 2007). Ultrasound utilized to evaluate asymptomatic shoulders found increased prevalence of full-thickness tears with increased age (Sher et al., 1995, Tempelhof et al., 1999), with approximately 6% among 212 individuals (Schibany et al., 2004) and in 7.6% of 420 patients (Moosmayer et al., 2009). Asymptomatic tears increase in prevalence by age – 50 to 59 (2.1%) versus 60 to 69 (5.7%) versus 70 to 79 (15%) (Moosmayer et al., 2009).

Ultrasound is thought to be relatively effective for identifying full-thickness tears (Middleton et al., 1986, Furtschegger et al., 1988, Mack et al., 1988, Mack et al., 1988, Brenneke et al., 1992, Iannotti et al., 1996, Zehetgruber et al., 2002, Ottenheijm et al., 2010, Smith et al., 2011); however, it appears somewhat less effective for identifying partial-thickness tears (Brenneke et al., 1992, Naredo et al., 1999, Ottenheijm et al., 2010, Smith et al., 2011). A surgical case series of 42 patients attempted to determine the diagnostic accuracy of ultrasound. Ultrasound detected all full-thickness tears (100% sensitive, 97% specific), but only 6 of 13 of the partial-thickness tears (46% sensitive, 97% specific). One full-thickness tear was falsely diagnosed. Another study has suggested sensitivity for detection of tear size of 83 to 86%. (Ianotti) Ultrasound has advantages of being able to move the arm actively or passively during the examination; it is less expensive; and it may be available in most centers. (Boykin, Friedman et al.) When conservative treatment failed, skilled physician's usingultrasound reportedly had high diagnostic accuracy identifying tendinopathy, calcifying tendonitis, and partial- and full-thickness tears. (Moosikasuwan, Miller et al. , Ottenheijm, Jansen et al.) SLAP lesions cannot be well visualized using ultrasound. (Hanchard, Lenza et al.) Impingement was felt to have been diagnosed in 27 of 34 cases (79% sensitive, 96% positive predictive value). (Read and Perko) A small study of ultrasound the day before surgery for shoulder arthritis in 20 patients suggested that ultrasound was accurate for evaluating hypertrophy of the bursa (93% sensitive, 83% specific), biceps tendon rupture (70% sensitive, 100% specific) and rotator cuff tear (83% sensitive, 57% specific). (Alasaarela, Leppilahti et al.) Ultrasound-guided MR arthrography was evaluated in an RCT with anterior versus posterior approaches and found equal ratings of discomfort. (Koivikko and Mustonen) Ultrasound is not invasive, is of low to moderate cost, and has little risk of adverse effects; therefore, although there are concerns that MRI may be superior for imaging most of shoulder soft tissue, ultrasound is recommended particularly for evaluation of rotator cuff tears as a complication of shoulder fracture(s). The main disadvantage is the high dependency on the physician's skills. (Boykin, Friedman et al. , Hanchard, Lenza et al.)

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and

reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

15.4.7. SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT) FOR SHOULDER OR CLAVICULAR FRACTURES

Not Recommended

Single-proton emission computed tomography (SPECT) is not recommended for the evaluation of patients with shoulder or clavicular fractures.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain. One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning. Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment, and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating shoulder disorders.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

15.4.8. POSITRON EMISSION TOMOGRAPHY (PET)

POSITRON EMISSION TOMOGRAPHY (PET) FOR SHOULDER OR CLAVICULAR FRACTURES

Not Recommended

Positron emission tomography (PET) is not recommended for the evaluation of patients with shoulder or clavicular fractures.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain. One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning. Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating shoulder disorders.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

15.5. TREATMENT RECOMMENDATIONS

15.5.1. INITIAL CARE

Initial care of a patient with fracture generally involves preclusion of use, prompt assessment of the severity, a determination of whether surgery or non-operative management is best, and education. Identification of accompanying disorders, such as rotator cuff tear, allows for treatment of a second condition to substantially reduce or resolve the symptoms. Over-the-counter analgesics, self-applications of heat and ice, and slings are used to treat non-displaced fractures and manage pain.

OVER-THE-COUNTER (OTC) ANALGESICS FOR TREATMENT OF SHOULDER OR CLAVICULAR FRACTURES

Recommended

Over-the-counter analgesics are recommended for treatment of shoulder or clavicular fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Shoulder fractures, usually as adjuncts to other treatments

Benefits

Self-management of the pain

Harms

Negligible for OTC analgesics unless acetaminophen doses exceed 3.5 g, or the patient has liver disease or other contraindications

Frequency/Dose/Duration

Analgesics should be used per manufacturer's recommendations

Indications for Discontinuation

Fracture healing, resolution of pain, lack of efficacy, intolerance, complication

Rationale

There are no quality trials evaluating analgesics for managing shoulder fractures. There is some evidence of delayed fracture healing with NSAIDs. However, analgesics and OTC NSAIDs are likely helpful and there is some quality evidence for the use of prescription NSAIDs for other shoulder nociceptive pain (see NSAIDs for rotator cuff tendinopathy). Thus, they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation,

random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SELF-APPLICATION OF HEAT OR ICE FOR TREATMENT OF SHOULDER OR CLAVICULAR FRACTURES

Recommended

Self-application of heat or ice is recommended for treatment of shoulder or clavicular fractures.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Shoulder fractures, usually as adjuncts to other treatments

Benefits

Self-management of the pain

Harms

Possible cold injuries or burns

Frequency/Dose/Duration

Self-applications of ice or heat are typically 3-5 times/day. Ice is more typically used in the acute phase for fractures.

Indications for Discontinuation

Fracture healing, resolution of pain, lack of efficacy, intolerance, complication

Rationale

There are no quality trials evaluating ice or heat for managing shoulder fractures. However, they may be helpful, have generally negligible adverse effects, are of negligible cost, and thus they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

15.5.2. MEDICATIONS

Over-the-counter medications may be helpful to manage pain. These especially include acetaminophen and NSAIDs (646,645), with NSAIDs showing greater efficacy, but overall acetaminophen has a generally greater safety profile. Generally, the only medications commonly used for fracture patients are NSAIDs and brief, post-operative use of opioids in select patients. Other medications may be indicated if there is osteopenia.

15.5.3. SURGICAL CONSIDERATIONS

Clavicular fractures are mostly managed non-operatively (sling and figure-8 brace) (2242,2243,2244,2245), while some are managed surgically with various techniques and procedures, including open reduction internal fixation with plates (2243,2246,2247,2248,2249), pins (930,2242,2243,2247,2250), wires, and nails (935,2243,2247,2251). Increased risks for nonunions include increasing age, female sex, comminution, and displacement (2074). Low-intensity pulsed ultrasound has also been used to attempt to accelerate healing of these fractures (2252,2253,2254,2255,2256,2257,2258,2259,2260,2261,2262).

NON-OPERATIVE TREATMENT FOR CLAVICULAR FRACTURES

Recommended

Non-operative treatment is recommended for most patients with clavicular fractures, especially among those with non-displaced fractures. Although non-operative management is an acceptable treatment option for some patients, most workers with displaced mid-clavicular fractures may prefer to have operative management due to faster functional recovery, faster return to work, and lower risk of non-union. Non-operative management is not recommended for comminuted fractures.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence High

Indications

Simple clavicular fractures, typically 2-part that are non-displaced and especially in younger patients. Selective displaced mid-clavicular fractures have also been shown to be successfully treated non-operatively (Melean et al., 2015, Ban et al., 2021, Ahrens et al., 2017, Virtanen et al., 2012). Comminuted mid-shaft fractures are poor candidates for non-operative management due to nonunion and malunions (Mirzatolooei, 2011). Surgery appears superior for management of ipsilateral scapular neck and clavicular shaft fractures (Lin et al., 2015).

Benefits

Typically, the fastest recovery with return of function among those with non-displaced fractures is achieved with non-operative management. Among worker's compensation patients with displaced mid-clavicular fractures, recovery may be faster among those operatively managed (Melean et al., 2015). Among general patients, recovery is faster with lower risk of non-union among those surgically treated for displaced midclavicular factures (Melean et al., 2015, Ban et al., 2021, Ahrens et al., 2017, Virtanen et al., 2012)(Tamaoki et al., 2017, Hall et al., 2021, Woltz et al., 2017, Robinson et al., 2013, Qvist et al., 2018, Bhardwaj et al., 2018).

Harms

Negligible among those with non-displaced fractures, unless there are complicating conditions present, co-morbidities or a more complex fracture. Among those with displaced mid-clavicular fractures, there is ~10-fold risk of non-union with non-operative compared with operative management in the RCT data, although long-term outcomes are comparable (Melean et al., 2015, Ban et al., 2021, Ahrens et al., 2017, Virtanen et al., 2012)(Tamaoki et al., 2017, Hall et al., 2021, Woltz et al., 2017, Robinson et al., 2013, Qvist et al., 2018, Bhardwaj et al., 2018).However, large registry data suggest nonunion rates of 5.9% among those nonoperatively treated compared with 5-6% among those operatively treated (Zlowodzki et al., 2005), which raise questions about risks in the general population compared with centers involved in RCTs. Among those with either 1) comminuted midshaft fractures or 2) psilateral scapular neck and clavicular shaft fractures, attempted non-operative management resulted in high rates of nonunion and malunion (Mirzatolooei, 2011, Lin et al., 2015).

Frequency/Dose/Duration

There is quality evidence from many quality RCTs that some closed displaced midclavicular fractures may be successfully treated with a sling or other non-operative means (Melean et al., 2015, Ban et al., 2021, Ahrens et al., 2017, Virtanen et al., 2012)(Tamaoki et al., 2017, Hall et al., 2021, Woltz et al., 2017, Robinson et al., 2013, Qvist et al., 2018, Bhardwaj et al., 2018)(Mirzatolooei, 2011, Lin et al., 2015, Judd et al., 2009, Ersen et al., 2015). Either sling or Figure-8 braces may be used with some evidence suggesting a simple sling is superior to figure-of eight bracing for midclavicular fractures

(Andersen et al., 1987). Non-displaced fractures can be treated with either, and there is not a consensus on preferred treatment as the figure-8 allows distal extremity movement (Eiff, 1997, Stanley et al., 1988, Andersen et al., 1987, McCandless et al., 1979, Khan et al., 2009). A low-quality trial suggested superiority of the addition of kinesiotaping to an arm sling (Dedeoglu et al., 2022). Slings and braces are used until tenderness and crepitance is resolved (Eiff, 1997).

Indications for Discontinuation

Operative management is indicated among those with nonunion, malunion, or poor/delayed healing.

Rationale

There is one trial comparing non-operative treatments and evidence in evaluating different outcome or complication factors is not uniformly in favor of one treatment approach. Thus, either a simple sling or a figure -8 brace is recommended (Andersen et al., 1987). The majority of clavicular fractures are believed to not require surgery (Eiff, 1997, Zlowodzki et al., 2005, Khan et al., 2009, Kim et al., 2008, Jeray, 2007, Denard et al., 2005, Craig, 1990, Graves et al., 2005, Miller et al., 1992, Quigley, 1950, Smekal et al., 2009). However, a sizeable minority of these fractures may be better treated with surgery which is often recommended for all open fractures, and for many patients with neurovascular compromise (Barbier et al., 1997, Chen et al., 2000, Chen et al., 2002, Connolly et al., 1989, Howard et al., 1965, Fujita et al., 2001, Miller et al., 1969, Kay et al., 1986, Bateman, 1968), multiple trauma, floating shoulders, Type II distal fractures and proximal fractures associated with sternoclavicular dislocations, coracoclavicular ligament disruption (Chen et al., 2002), malunions, and painful non-unions (Eiff, 1997, Jeray, 2007, Graves et al., 2005, Chen et al., 2002, Jones et al., 2000).

There is quality evidence from many RCTs that displaced midclavicular fractures achieve the same long-term outcomes whether treated with a sling or other non-operative means compared with surgical fixation (Melean et al., 2015, Ban et al., 2021, Ahrens et al., 2017, Virtanen et al., 2012, Mirzatolooei, 2011, Tamaoki et al., 2017, Hall et al., 2021, Woltz et al., 2017, Robinson et al., 2013, Qvist et al., 2018, Bhardwaj et al., 2018, Lin et al., 2015, Judd et al., 2009, Ersen et al., 2015). Most studies suggest contrasting risks of: 1) small but detectable increased risks of reoperations in the surgical arms (e.g., plate removals), while 2) also showing higher rates of non-union in the non-operative arms. One trial in worker's compensation patients reported faster return to work and function among those treated operatively (2.9 vs. 3.7 months) (Melean et al., 2015). The available evidence shows higher rates of union in those receiving surgery, but the overall numbers of complications are not improved with surgery. While the quality evidence in favor of lower non-union and malunion rates moderately supports surgical approaches, the total numbers of complications is higher in the operative than non-operative group. Thus, careful consideration must be used with either approach (Canadian Orthopaedic Trauma Society, 2007, Judd et al., 2009, Smekal et al., 2009, Altamimi et al., 2008).

Comminuted mid-shaft fractures are poor candidates for non-operative management due to high rates of nonunion and malunions (Mirzatolooei, 2011). Surgery appears superior for management of ipsilateral scapular neck and clavicular shaft fractures (Lin et al., 2015).

Simple clavicular fractures have excellent healing, full return of function, require minimal management, and are recommended for non-operative treatment. Among patients with displaced midclavicular fractures, non-operative management may be selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Of the 32 articles considered for inclusion, 15 randomized trails and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SURGICAL TREATMENT FOR CLAVICULAR FRACTURES

Sometimes Recommended

Surgical intervention is moderately recommended for select patients with clavicular fractures.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence High

Indications

Surgical indications are largely based on numerous factors that are assessed and evaluated in aggregate by the orthopedic surgeon, including surgeon's preferences and experiences, open fractures, multiple-part fractures, degree of displacement, associated vascular injuries, polytrauma, increasing age, bone quality, hand dominance, medical comorbidities, bilateral fractures, neurological loss after penetrating injuries, unacceptable alignment, and failure of non-operative treatment (Society, 2007, Judd et al., 2009, Smekal et al., 2009, Altamimi et al., 2008). Fractures of the lateral end of the clavicle are recommended for surgical treatment. Another consideration is that there is one trial of worker's compensation patients with displaced midclavicular fractures, and it showed faster recovery among those operatively managed compared with non-operative management (Melean et al., 2015).

Benefits

Superior healing and recovery. Reduced risk of infection if the fracture was open. Reduced risk of nonunion if surgical repaired (Melean et al., 2015, Ban et al., 2021, Ahrens et al., 2017, Virtanen et al., 2012).

Harms

Surgical complications, infection, adhesive capsulitis. Risk of a second surgical procedure being needed.

Rationale

The majority of clavicular fractures do not require surgery (Eiff, 1997, Zlowodzki et al., 2005, Khan et al., 2009, Kim et al., 2008, Jeray, 2007, Denard et al., 2005, Craig, 1990, Graves et al., 2005, Miller et al., 1992, Quigley, 1950, Smekal et al., 2009, Preston et al., 2009). However, a sizeable minority of these fractures may be better treated with surgery, which is often recommended for all open fractures, and for many patients with neurovascular compromise (Barbier et al., 1997, Chen et al., 2000, Chen et al., 2002, Connolly et al., 1989, Howard et al., 1965, Fujita et al., 2001, Miller et al., 1969, Kay et al., 1986, Bateman, 1968), multiple trauma, displaced fractures (Smekal et al., 2009), floating shoulders, Type II distal fractures and proximal fractures associated with sternoclavicular dislocations, coracoclavicular ligament disruption (Chen et al., 2002), malunions, and painful non-unions (Eiff, 1997, Jeray, 2007, Graves et al., 2005, Chen et al., 2002, Jones et al., 2000).

There is evidence from many quality RCTs that displaced midclavicular fractures achieve the same long-term outcomes whether treated with a sling or other non-operative means compared with surgical fixation (Melean et al., 2015, Ban et al., 2021, Ahrens et al., 2017, Judd et al., 2009, Ersen et al., 2015). However, most studies suggest contrasting risks of: 1) small but detectable increased risks of reoperations in the surgical arms (e.g., plate removals), while 2) also showing ~10-fold higher rates of non-union in the non-operative arms. However, large registry data suggest nonunion rates of 5.9% amongt those nonoperatively treated compared with 5-6% among those operatively treated (628), which raises questions about risks in the general population compared with centers involved in RCTs. One trial in worker's compensation patients reported faster return to work and function among those treated operatively (2.9 vs. 3.7 months) (Melean et al., 2015). Thus, among most worker's compensation patients, surgery may be preferable to non-operative management of these fractures, although non-operative management may be acceptable under select circumstances (e.g., risk of surgery). Surgical fixation of mid-shaft fractures most commonly involves intramedullary fixation (Grassi et al., 2001, Neviaser et al., 1975) and plate fixation (Kloen et al., 2009, Graves et al., 2005, Kabak et al., 2004, Bradbury et al., 1996, Jupiter et al., 1987, Fuglesang et al., 2017, van der Meijden et al., 2015, Hulsmans et al., 2017, Sohn et al., 2015, Andrade-Silva et al., 2015, King et al., 2019, Zehir et al., 2015, Calbiyik et al., 2017, Narsaria et al., 2014). While the quality evidence in favor of lower non-union and malunion rates moderately supports surgical approaches, the total numbers of complications is higher in the operative than non-operative group. Thus, careful consideration must be used with either approach (Society, 2007, Judd et al., 2009, Altamimi et al., 2008, Smekal et al., 2009).

Comminuted mid-shaft fractures are poor candidates for non-operative management due to high rates of nonunion and malunions (Mirzatolooei, 2011). Surgery appears superior for management of ipsilateral scapular neck and clavicular shaft fractures (Lin et al., 2015).
Fractures of the lateral end of the clavicle have a high rate of non-union ((Robinson et al., 2004, Khan et al., 2009). Type II fractures of the distal third of the clavicle (Neer, 1968) (coracoclavicular ligaments remain attached to distal fragment and proximal fragment displaced superiorly) are recommended for referral to an orthopedist for consideration of operative treatment due to high rates of non-union (Eskola et al., 1987, Eiff, 1997, Zenni et al., 1981, Anderson, 2003, Edwards et al., 1992, Post, 1989, Katznelson et al., 1976, Poigenfurst et al., 1992, Wang et al., 2020, Orlandi et al., 2022, Yan et al., 2017). Fractures of the proximal 1/3 of the clavicle with either significant displacement or sternoclavicular dislocation are recommended for referral to an orthopedist (Eiff, 1997).
Treatment for simple displaced fractures remains controversial (Melean et al., 2015, Ban et al., 2021, Ahrens et al., 2017, Judd et al., 2009, Ersen et al., 2015, Khan et al., 2009). There are some trials of more complex clavicular fracture management. There are many indications for surgical management,

although the vast majority of clavicular fractures are able to be managed non-operatively. Surgical management is recommended for these many indications (see common examples above).

Mid-shaft fractures are fixed with either intramedullary screws/pins or plates with screws; however, there are few quality trials comparing the different options. Thus, the overall evidence is not definitive. There are many studies of biomechanical responses to assess risks of fracture (Kemper et al., 2009), as well as failure of surgical fixation (Robertson et al., 2009, Celestre et al., 2008, Proubasta et al., 2002). Importantly, these failure rates might be more important for patients with higher physical activities.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 1 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 1 from other sources. Of the 33 articles considered for inclusion, 33 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

15.5.4. REHABILITATION PROGRAMS

Supervised therapy is infrequently needed for clavicular fractures (945). Exceptions may include complicated fractures, fractures in the elderly, or fractures in patients with comorbidities.

LOW-INTENSITY PULSED ULTRASOUND FOR TREATMENT OF TYPE I CLAVICULAR FRACTURES

Not Recommended

Low-intensity pulsed ultrasound is moderately not recommended for treatment of Type I (mid-shaft) clavicular fractures.
Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Rationale

One high-quality RCT of Type I clavicle (diaphyseal) fractures found no evidence of efficacy of ultrasound to accelerate healing (Lubbert et al., 2008). Thus, this intervention is not recommended for those fractures. However, favorable results reported for healing disparate nonunion fracture types in uncontrolled studies (Nolte et al., 2001) and some evidence for other fractures (Busse, 2009) does

suggest that there may be some role for low-intensity pulsed ultrasound for select clavicle fractures that has not yet been defined but, if successful, may involve more severe fracture types, risks for non-unions, or post-operative settings with risks of non-union.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Of the 32 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

LOW-INTENSITY PULSED ULTRASOUND FOR TREATMENT OF NON-TYPE 1 CLAVICULAR FRACTURES

No Recommendation

Post-operative use of low-intensity pulsed ultrasound is not recommended for treatment of all other (non-Type 1) clavicle fractures or non-unions.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One high-quality RCT of Type I clavicle (diaphyseal) fractures found no evidence of efficacy of ultrasound to accelerate healing (Lubbert et al., 2008). Thus, this intervention is not recommended for those fractures. However, favorable results reported for healing disparate nonunion fracture types in uncontrolled studies (Nolte et al., 2001) and some evidence for other fractures (Busse, 2009) does suggest that there may be some role for low-intensity pulsed ultrasound for select clavicle fractures that has not yet been defined but, if successful, may involve more severe fracture types, risks for non-unions, or post-operative settings with risks of non-union.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EARLY MOBILIZATION FOR CLAVICULAR FRACTURES

Sometimes Recommended

Early mobilization is selectively recommended for clavicular fractures, post-surgical patients and/or among those with co-morbidities.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Select patients with complex clavicular fractures, post-surgical patients and/or among those with co-morbidities.

Benefits

Earlier and improved return to function

Harms

Theoretical aggravation of a fracture if begun before sufficiently healed.

Frequency/Dose/Duration

The goal is to begin range of motion as early as possible to help prevent stiffness. Frequent follow-up may help to transition the patient from immobilization to motion. Begin range of motion once fracture is stable (very early for stable impacted fractures). Other fractures can wait until the clavicle moves as if it is one unit- up to four weeks for most fractures. Treating orthopedist must ascertain whether early mobilization is appropriate. Considerations include patient age, fracture type, post-reduction or post-surgical results, comorbidities. Early mobilization generally starts within 1 week.

Rationale

There are no quality studies of clavicular fractures, but multiple trials of proximal humeral fractures suggesting efficacy of early mobilization .(Hodgson et al., 2007, Hodgson et al., 2003, Lefevre-Colau et al., 2007, Agorastides et al., 2007)(Kristiansen et al., 1989). Thus, by analogy to proximal humeral fractures, early mobilization is not invasive, appears to have few adverse effects, is likely cost-effective, and thus recommended for complex clavicular fractures, post-surgical patients and/or among those with co-morbidities.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

EDUCATION AND EXERCISES FOR CLAVICULAR FRACTURES

Sometimes Recommended

Education and exercise are selectively recommended for complex clavicular fractures, post-surgical patients, and/or among those with co-morbidities.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Select patients with complex clavicular fractures, post-surgical patients, and/or among those with co-morbidities.

Benefits

Improved compliance with the rehabilitation program and faster return of function.

Harms

Negligible

Frequency/Dose/Duration

Education may include adaptive techniques and use of adaptive equipment (as indicated) to facilitate continued participation in daily activities despite limitations of shoulder.

Rationale

There are no quality studies of clavicular fractures, but multiple trials of proximal humeral fractures suggesting efficacy of education and exercises (Kristiansen et al., 1989, Hodgson et al., 2003, Lefevre-Colau et al., 2007, Hodgson et al., 2007, Agorastides et al., 2007). Thus, by analogy to proximal humeral fractures, education and exercises are not invasive, appear to have few adverse effects, are likely cost-effective, and thus are recommended for complex clavicular fractures, post-surgical patients, and/or among those with co-morbidities.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SELF-TRAINING FOR CLAVICULAR FRACTURES

Sometimes Recommended

Self-training exercise is selectively recommended for those with clavicular fractures, post-surgical patients and/or among those with co-morbidities.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Select patients with complex clavicular fractures, post-surgical patients, and/or among those with co-morbidities who are motivated and compliant with exercises to rehabilitate the injury (Lungberg et al., 1979, Bertoft et al., 1984, Revay et al., 1992).

Rationale

There are no quality studies of clavicular fractures, but multiple trials of proximal humeral fractures suggesting efficacy of early mobilization (Lungberg et al., 1979, Bertoft et al., 1984, Revay et al., 1992). Thus, by analogy to proximal humeral fractures, self-training is not invasive, appears to have few adverse effects, likely cost-effective, and thus is recommended for complex clavicular fractures, post-surgical patients and/or among those with co-morbidities.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: shoulder fractures, shoulder fracture; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,782 articles in PubMed, 39,900 in Google Scholar, and 0 from other sources†. We considered for inclusion 27 from PubMed, 2 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: clavicle fractures bone, clavicular fractures bone, clavicle fractures, clavicular fractures; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,280 articles in PubMed, 17,100 in Google Scholar, and 0 from other sources†. We considered for inclusion 32 from PubMed, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

15.5.5. FOLLOW-UP VISITS

Patients with clavicular fractures generally require a few follow-up appointments as the prognosis is mostly excellent. Appointments are needed for monitoring symptoms, advancing treatment, advancing activities, and gradually reducing limitations. For those patients needing surgery, there are far more apointments needed and/or there are needs to treat a co-existent condition. Frequencies of appointments may also be greater if workplace limitations are required and job demands are higher or may require job modifications or adaptive equipment. Post-operative rehabilitation can be considerable, particularly in older patients with other associated injuries such as rotator cuff injuries. In those cases, there may be a requirement for therapy on a prolonged basis to recover as much function as possible.

16. BRACHIAL PLEXUS INJURIES

16.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing brachial plexus injuries from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level

- Insufficient – Not Recommended (Consensus-based), “I” Level
- Not Recommended, “C” Level
- Moderately Not Recommended, “B” Level
- Strongly Not Recommended, “A” Level

16.2. OVERVIEW

Brachial plexopathies among workers have many, mostly high-force causes including motor vehicle accidents, sporting activities (especially football), bicycle accidents, industrial accidents, falls from heights, objects falling on a shoulder, and sequelae of fractures. However, there are many other cuases including birth palsies, use of backpacks (Rucksack paralysis), autoimmune neuropathies, infections, space occupying vascular lesions, hematomas from axillary artery punctures and procedures, sequelae of orthopedic shoulder or chest procedures, and primary tumors, metastases and post-radiation (2263,2264,2265,2266,148,2267,2268,2269,2270,2271,2272,2273,1174,2274,2275,2276). Brachial plexus injuries from trauma in the context of work are considered occupational (948,148). Moderate to severe brachial plexus injuries previously had poor prognoses and remotely, amputation was sometimes performed (949). More recent results are considerably more promising. Only brachial plexopathy due to injuries will be reviewed in this section. Thoracic outlet syndrome is addressed in a separate module.

Brachial plexus injuries are quite heterogenous, ranging from mild “burner” or “stinger” football injuries (946) to complete avulsions of nerve roots (947). Depending on the degree of axonal damage, the prognoses vary from excellent to poor (947). These injuries have been divided into supraclavicular and infraclavicular injuries based on the main location of the injury as proximal or distal to nerve branches (148), with the supraclavicular thought to be more severe and more painful (948). Case series suggest most of these injuries occur in young males involved in motor vehicle accidents (948,2277). They are frequently accompanied by other injuries including concussions, other head trauma, rib fractures, shoulder girdle fractures, shoulder dislocations, humeral fractures, cervical spine injuries, and internal thoracic injuries, suggesting an associated death rate of 3.7% for those presenting to a regional trauma facility (948); many additional mild or isolated cases are not treated in trauma facilities.

Clinical suspicion leading to a careful history and focused physical examination is usually diagnostic (148,947). Weakness is present, sometimes with pain (148). Evaluating traumatic cases often involves x-ray to screen for fractures, potentially including the humerus, clavicle, scapula, cervical spine, and chest (148,947). Computerized tomography, sometimes with myelography, may be helpful in select cases for imaging the spine (947). However, MRI is generally the imaging procedure of choice after fractures have been ruled out or if additional studies are necessary (947,148,2278,2279,2280,2281). Electrodiagnostic studies are thought to be confirmatory in moderate to severely affected patients when performed at least 3 to 4 weeks after the injury to allow sufficient time for Wallerian degeneration (148,947). Electrodiagnostics are also used for intraoperative assessments (947).

16.3. DIAGNOSTIC RECOMMENDATIONS

16.3.1. LABORATORY TESTS

LABORATORY TESTS FOR NEUROPATHIC PAIN

Recommended

Laboratory tests are selectively recommended as a screen to evaluate specific disorders (e.g., diabetes mellitus, alcohol) that may cause or contribute to peripheral neuropathic pain.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Patients with ongoing peripheral neuropathic pain that is not responding clinically as expected, including brachial plexopathies, and without prior diagnostic evaluations. Diagnostic testing should generally include fasting glucose and either hemoglobin A1c and/or 2-hour glucose tolerance testing. The threshold should be low for testing for signs of alcohol abuse (i.e., CBC with Mean Cell Volume, GGTP, AST and ALT). Testing is advisable even if other diagnostic testing finds another disorder (e.g., occupational neurotoxin) to assure there is not a treatable contributing factor.

Benefits

Diagnosing a latent condition. As there is evidence that multiple disorders interact to raise risk of neuropathy, addressing all causes is also thought to produce a more favorable prognosis.

Harms

Negligible

Frequency/Dose/Duration

One evaluation. A second evaluation may be indicated when either there is a significant change in exposure (e.g., substantial weight gain) or symptoms change.

Rationale

Diabetes mellitus (or pre-diabetes/glucose intolerance) and alcohol abuse are important to treat to facilitate improvements in peripheral neuropathic pain. Serological tests are minimally invasive, unlikely to have substantial adverse effects, are low to moderately costly depending on the specific test ordered, have evidence of diagnostic efficacy and are thus recommended for focused testing of a few diagnostic considerations.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: X-Ray, Radiography, Diagnostic Imaging; brachial plexus; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 6,059 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 6,059 articles, 23 in CINAHL, 213 in Cochrane Library, 32,400 in Google Scholar,

and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.3.2. X-RAYS

RADIOGRAPHS (X-RAYS) TO DIAGNOSE BRACHIAL PLEXUS INJURIES

Recommended

Laboratory tests are selectively recommended as a screen to evaluate specific disorders (e.g., diabetes mellitus, alcohol) that may cause or contribute to peripheral neuropathic pain.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Most patients with brachial plexus injuries are candidates for cervical spine and/or shoulder x-rays, especially for significant trauma, pain without trending towards improvement, impaired use, and those with red flags.

Benefits

Diagnosis of a fracture, calcific tendinitis, or otherwise latent medical condition(s).

Harms

Medicalization or worsening of otherwise benign shoulder condition; minor radiation exposure.

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient with two to three views of the cervical spine and/or shoulder. For patients with chronic pain, it may be reasonable to obtain a second set of cervical spine and/or shoulder x-rays later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

X-rays are helpful to evaluate most patients with brachial plexus-related, both to diagnose and to assist with the differential diagnostic possibilities such as fractures and arthroses (Harreld et al., 2009, Ficat, 1985). X-rays are non-invasive, low to moderate costly, and have little risk of adverse effects, and therefore are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: X-Ray, Radiography, Diagnostic Imaging; brachial plexus; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 6,059 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 6,059 articles, 23 in CINAHL, 213 in Cochrane Library, 32,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.3.3. COMPUTED TOMOGRAPHY

Computed tomography remains an important imaging procedure, particularly for bony anatomy, whereas MRI is superior for soft tissue abnormalities. However, most patients have issues with soft tissue rather than bony abnormalities in the shoulder, thus on a population-basis, far fewer CT scans are ordered. CT may nevertheless be useful for shoulder joint abnormalities where advanced imaging of the bones is required (i.e., complex proximal humerus fracture, scapular fracture). CT also may be useful to evaluate the anatomy in patients with contraindications for MRI (most typically an implanted metallic-ferrous device). CT arthrogram is often preferred when evaluating posterior or anterior glenohumeral instability when the bony anatomy needs to be better defined – glenoid deficiency and humeral Hill-Sachs – as MRI is not as good for bone imaging. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear.

CT MYELOGRAPHY TO DIAGNOSE BRACHIAL PLEXUS INJURIES

Sometimes Recommended

CT myelography is selectively recommended for the evaluation of brachial plexus injuries.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Patients thought to have an acute, clinically significant brachial plexus injury who also have concerns for osseous injury (e.g., cervical spine) and/or potentially confounding conditions with a contraindication for MRI (e.g., ferrous implant). CT myelography is generally superior to CT for evaluation of plexopathy cases and is helpful to identify nerve root lesions.

Benefits

Secure a diagnosis and that of a confounding condition.

Harms

Negligible, radiation exposure

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

There are no quality trials on the use of CT to evaluate brachial plexus injuries. However, there are studies of CT myelography and data conflict regarding whether CT myelography is superior to MRI (Bordalo-Rodrigues et al., 2020, Carvalho et al., 1997) or whether the two imaging techniques have comparable rates of detection of cervical nerve root avulsion (Van der Linde et al., 2015, Doi et al., 2002). These injuries are disparate in nature and require an individualized approach, particularly for the more severe cases. MRI is considered superior to CT for imaging most neck/shoulder abnormalities where advanced imaging of soft tissues is usually the primary concern. However, where imaging calcified structures is required, CT is considered superior. This includes complex and occult fractures. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear. CT myelography is helpful for evaluation of plexopathies. CT is also helpful for imaging of potentially confounding injuries such as osseous injuries and occult fractures, and thus for most brachial plexus injuries, MRI is considered the best imaging tool available and so CT is only selectively recommended. CT myelography however has a more central role in evaluation of these injuries.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Of the 42 articles considered for inclusion, 5 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

COMPUTED TOMOGRAPHY (CT) TO DIAGNOSE BRACHIAL PLEXUS INJURIES

Sometimes Recommended

Computed tomography (without myelography) is selectively recommended for the evaluation of brachial plexus injuries.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Patients thought to have an acute, clinically significant brachial plexus injury who also have concerns for osseous injury (e.g., cervical spine) and/or potentially confounding conditions with a contraindication for MRI (e.g., ferrous implant). CT myelography is generally superior to CT for evaluation of plexopathy cases and is helpful to identify nerve root lesions.

Benefits

Secure a diagnosis and that of a confounding condition.

Harms

Negligible, radiation exposure

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

There are no quality trials on the use of CT to evaluate brachial plexus injuries. However, there are studies of CT myelography, and data conflict regarding whether CT myelography is superior to MRI (Bordalo-Rodrigues et al., 2020, Carvalho et al., 1997) or whether the two imaging techniques have comparable rates of detection of cervical nerve root avulsion (Doi et al., 2002, Van der Linde et al., 2015). These injuries are disparate in nature and require an individualized approach, particularly for the more severe cases. MRI is considered superior to CT for imaging most neck/shoulder abnormalities where advanced imaging of soft tissues is usually the primary concern. However, where imaging calcified structures is required, CT is considered superior. This includes complex and occult fractures. CT arthrogram can be used in place of MRI to evaluate for rotator cuff tear. CT myelography is helpful for evaluation of plexopathies. CT is helpful for imaging of potentially confounding injuries such as osseous injuries and occult fractures, and thus for most brachial plexus injuries, MRI is considered the best imaging tool available and so CT is only selectively recommended. CT myelography however has a more central role in evaluation of these injuries.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.3.4. ELECTROMYOGRAPHY (INCLUDING NERVE CONDUCTION STUDIES)

See the ACOEM Cervical and Thoracic Spine Disorders and Hand, Wrist, and Forearm Disorders for discussions regarding use of electrodiagnostic studies for evaluation of cervical spine and distal upper extremity-related disorders that may present as shoulder pain. Electrodiagnostic studies have also been used to confirm diagnostic impressions of other peripheral nerve entrapments, brachial plexopathies, and neurologic component of thoracic outlet syndrome.

ELECTROMYOGRAPHY AND NERVE CONDUCTION STUDIES TO DIAGNOSE BRACHIAL PLEXUS INJURIES

Recommended

Electrodiagnostic studies are recommended to assist in the diagnosis of subacute or chronic brachial plexus injuries, as well as injuries to the long thoracic nerve and suprascapular nerve.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence High

Indications

Patients with subacute or chronic paresthesias with or without pain, particularly when the diagnosis is unclear. As EMG abnormalities require at least 3 weeks to develop changes, indications require failure to resolve or trend towards resolution after waiting 4 to 6 weeks (which also allows for potential clinical improvement), equivocal imaging findings such as CT or MRI, and suspicion by history and physical examination that a brachial plexopathy and/or radiculopathy may be present and there is a need to define the disorder with an anticipated potential need to change the treatment approach.

Benefits

Identification of neurological disorders, including plexopathy, radiculopathy, and peripheral nerve entrapment.

Harms

Negliglble.

Frequency/Dose/Duration

Generally only one test is needed. If the test is obtained too early, a repeat study may be needed if symptoms persist or progress to ascertain whether the test becomes abnormal with time.

Rationale

Electrodiagnostic studies may assist in confirming peripheral nerve entrapments such as the long thoracic nerve and suprascapular nerve. These studies are minimally invasive, have minimal potential for adverse effects, and are moderate to high cost depending on the extent of the testing required.

Two comparative studies suggest nerve conduction studies are superior to MRI for the detection of plexus injuries (Caporrino et al., 2014, Chanlalit et al., 2005). Electrodiagnostic studies are considered

to have a central role in the evaluation of brachial plexus injuries, there is evidence of their utility, and thus, they are recommended.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Electromyography, EMG; brachial plexus; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 3,543 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 3,543 articles, 13 in CINAHL, 27 in Cochrane Library, 12,200 in Google Scholar, and 0 from other sources†. We considered for inclusion 2 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 1 from Google Scholar, and 0 from other sources. Of the 3 articles considered for inclusion, 3 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.3.5. MAGNETIC RESONANCE IMAGING

MAGNETIC RESONANCE IMAGING TO DIAGNOSE BRACHIAL PLEXUS INJURIES

Recommended

Magnetic resonance imaging (MRI) is recommended for patients suspected of having acute, clinically significant brachial plexus injuries. It is also recommended for select patients with subacute or chronic shoulder pain thought to potentially confounding conditions such as a symptomatic rotator cuff tear.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Patients thought to have an acute, clinically significant brachial plexus injury. MRI is also helpful for those injury cases where other confounding conditions may be present, such as cervical radiculopathy or rotator cuff injury. An MRI order would require specification of the body part(s) to be imaged.

Benefits

Secure a diagnosis and that of a confounding condition.

Harms

Negligible

Frequency/Dose/Duration

A second study is rarely needed, and should be based on significant changes in symptoms and examination.

Rationale

MRI has reported 39-96% sensitivity and 26-95% specificity for the detection of brachial plexus injury compared with surgical results (Hems et al., 1999, Tagliafico et al., 2012, Gad et al., 2020, Hung et al., 2020, Veronesi et al., 2018, Acharya et al., 2020, Trung, 2021, Ochi et al., 1994, Zhang et al., 2018, Gerevini et al., 2008). MRI also has 79% sensitivity for cervical nerve root avulsion compared with surgical results (788). Data conflict regarding whether CT myelography is superior to MRI (Bordalo-Rodrigues et al., 2020, Carvalho et al., 1997) or whether the two imaging techniques have comparable rates of detection of cervical nerve root avulsion (Doi et al., 2002, Van der Linde et al., 2015). Comparable images are obtained, although with faster acquisition, with 3-dimensional isotropic resolution fast spin echo MRI compared with conventional MRI (Tagliafico et al., 2012). Axial T2-drive MRI myelography was found 100% sensitive and 97% specific compared with surgical exploration (Elsakka et al., 2022), and 3D MR myelography is reportedly 89% sensitive and 95% specific for detection of avulsed nerve roots (Gasparotti et al., 1997). 3D diffusion-weighted steady-state free precession high resolution MRI is reportedly 97% sensitive and 90% specific for the detection of brachial plexus injuries (Qin et al., 2016). Two comparative studies suggest nerve conduction studies are superior to MRI for the detection of plexus injuries (Caporrino et al., 2014, Chanlalit et al., 2005). A study of US found MRI was overall superior and there was only limited utility of US compared with MRI (Caldana et al., 2018).

MR neurography has also been used to evaluate brachial plexus injuries (Fisher et al., 2016, Crim et al., 2017, Sneag et al., 2020, Mabrouk et al., 2021, Du et al., 2010). The sensitivity was reported to be 41-71% and specificity was 97-100% (Crim et al., 2017). However, the comparisons do not include findings based on surgery.

These injuries are disparate in nature and require an individualized diagnostic approach, particularly for the more severe cases. MRI is considered the best imaging test for soft tissues. MRI is also helpful for evaluation of potentially confounding injuries such as rotator cuff. Thus, for most brachial plexus injuries, MRI is considered the best imaging tool available and is recommended.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Magnetic Resonance Imaging, MRI; brachial plexus; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 2113 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 2113 articles, 78 in CINAHL, 32 in Cochrane Library, 24200 in Google Scholar, and 0 from other sources†. We considered for inclusion 37 from PubMed, 4 from CINAHL, 0 from Cochrane Library, 16 from Google Scholar, and 0 from other sources. Of the 57 articles considered for inclusion, 54 diagnostic studies and 3 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MAGNETIC RESONANCE NEUROGRAPHY FOR DIAGNOSING BRACHIAL PLEXUS INJURIES

Recommended

Magnetic resonance neurography (MRN) is recommended for patients suspected of having acute, clinically significant brachial plexus injuries. It is also recommended for select patients with subacute or chronic shoulder pain thought to potentially confounding conditions such as a symptomatic rotator cuff tear.
Strength of evidence Moderately Recommended, Evidence (B)
Level of confidence Moderate

Indications

Patients thought to have an acute, clinically significant brachial plexus injury. MRN is also helpful for those injury cases where other confounding conditions may be present, such as cervical radiculopathy or rotator cuff injury. An MRN order would require specification of the body part(s) to be imaged.

Benefits

Secure a diagnosis and that of a confounding condition.

Harms

Negligible

Frequency/Dose/Duration

A second study is rarely needed and should be based on significant changes in symptoms and examination.

Rationale

MRN has reported 39-96% sensitivity and 26-95% specificity for the detection of brachial plexus injury compared with surgical results (Hems et al., 1999, Tagliafico et al., 2012, Gad et al., 2020, Hung et al., 2020, Veronesi et al., 2018, Acharya et al., 2020)(Trung, 2021, Zhang et al., 2018, Gerevini et al., 2008). MRI also has 79% sensitivity for cervical nerve root avulsion compared with surgical results (Wade et al., 2018). Data conflict regarding whether CT myelography is superior to MRI (Bordalo-Rodrigues et al., 2020, Carvalho et al., 1997) or whether the two imaging techniques have comparable rates of detection of cervical nerve root avulsion (Doi et al., 2002, Van der Linde et al., 2015). Comparable images are obtained, although with faster acquisition, with 3-dimensional isotropic resolution fast spin echo MRI compared with conventional MRI (Tagliafico et al., 2012). Axial T2-drive MRI myelography was found 100% sensitive and 97% specific compared with surgical exploration (Elsakka et al., 2022), and 3D MR myelography is reportedly 89% sensitive and 95% specific for detection of avulsed nerve roots (Gasparotti et al., 1997). 3D diffusion-weighted steady-state free precession high resolution MRI is reportedly 97% sensitive and 90% specific for the detection of brachial plexus injuries (Qin et al., 2016). Two comparative studies suggest nerve conduction studies are superior to MRI for the detection of plexus injuries (Caporrino et al., 2014, Chanlalit et al., 2005). A study of US found MRI was overall superior and there was only limited utility of US compared with MRI (Caldana et al., 2018).

MR neurography has also been used to evaluate brachial plexus injuries (Fisher et al., 2016, Crim et al., 2017, Sneag et al., 2020, Mabrouk et al., 2021, Du et al., 2010). The sensitivity is reported as 41-71% and specificity 97-100% (Crim et al., 2017). However, the comparisons do not include findings based on surgery.

These injuries are disparate in nature and require an individualized diagnostic approach, particularly for the more severe cases. MRI/MRN is considered the best imaging test for soft tissues, MRI is also helpful for evaluation of potentially confounding injuries such as rotator cuff, and thus for most brachial plexus injuries, MRI/MRN is considered the best imaging tool available and is thus recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Of the 42 articles considered for inclusion, 5 diagnostic studies and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.3.6. ULTRASOUND

ULTRASOUND TO DIAGNOSE BRACHIAL PLEXUS INJURIES

Not Recommended

Ultrasound is not recommended for evaluation of brachial plexus injuries. There are other indications for its use.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

A study found MRI was generally superior to ultrasound, which had limited utility compared with MRI (Caldana et al., 2018). Because there is no clear rationale for its use in the evaluation of brachial plexus injuries and evidence of inferiority, ultrasound is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Ultrasound, Ultrasonography; brachial plexus; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive

value, predictive value of tests, efficacy, and efficiency. We found and reviewed 6,213 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 6,213 articles, 94 in CINAHL, 397 in Cochrane Library, 22,800 in Google Scholar, and 0 from other sources†. We considered for inclusion 1 from PubMed, 1 from CINAHL, 0 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 3 diagnostic studies and 1 systematic review met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.3.7. SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT) TO DIAGNOSE BRACHIAL PLEXUS INJURIES

Not Recommended

Single-proton emission computed tomography (SPECT) is not recommended for the evaluation of patients with brachial plexus injuries.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain including brachial plexus injuries. One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning. Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating shoulder disorders including brachial plexus injuries.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Positron Emisson Tomography, Single-Photon Emission-Computed Tomography, PET, SPECT; brachial plexus; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 114 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 114 articles, 1 in CINAHL, 214 in Cochrane Library, 3,310 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If

relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.3.8. POSITRON EMISSION TOMOGRAPHY (PET)

POSITRON EMISSION TOMOGRAPHY (PET) TO DIAGNOSE BRACHIAL PLEXUS INJURIES

Not Recommended

Positron emission tomography (PET) scanning is not recommended for the evaluation of patients with brachial plexus injuries.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain including brachial plexus injuries. One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning. Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating shoulder disorders including brachial plexus injuries.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Positron Emission Tomography, Single-Photon Emission-Computed Tomography, PET, SPECT; brachial plexus; diagnosis, diagnostic, sensitivity, specificity, positive predictive value, negative predictive value, predictive value of tests, efficacy, and efficiency. We found and reviewed 114 articles in PubMed using Most Recent tab, and we did a secondary search in PubMed using Best Match tab to find and review 114 articles, 1 in CINAHL, 214 in Cochrane Library, 3,310 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.4. TREATMENT RECOMMENDATIONS

16.4.1. MEDICATIONS

Mild cases of brachial plexopathy, such as mild football traction injuries, have an excellent prognosis with non-operative treatment (148,946,947). Provided the extent of axonal damage is minimal, non-operative treatment has been recommended (947,148). In the absence of quality evidence, these mild

injuries should be treated as neuropathic pain (see recommendations in the ACOEM Chronic Pain Guideline). Briefly, recommended medications include NSAIDs (Evidence C); concomitant use of cytoprotective agents in patients with a high risk factor profile who also have indications for NSAIDs (Evidence C); acetaminophen particularly if NSAIDs are contraindicated (Evidence C); tricyclic anti-depressants (Evidence C); carbamazepine as a potential adjunct as a 4th- or 5th-line treatment for neuropathic pain (Evidence C); carbamazepine as a potential adjunct as a fourth- or fifth-line treatment (Evidence I); gabapentin and pregabalin (Evidence A); dextromethorphan for select patients (Evidence C); muscle relaxants for brief use as a 2nd- or 3rd- line agent in acute exacerbations (Evidence I); and opioids for select patients (Evidence I).

16.4.2. ALLIED HEALTH INTERVENTIONS

Self-applications of heat or cryotherapies may be helpful for symptom modulation and are recommended to treat brachial plexus injuries. Therapy including education and exercise is also recommended. Acupuncture and other physical methods such as massage, diathermy, and magnets have been used to treat shoulder pain that includes brachial plexus injuries.

ACUPUNCTURE FOR TREATMENT OF CHRONIC PAIN FROM BRACHIAL PLEXUS INJURIES

Not Recommended

Acupuncture is not recommended to control chronic pain associated with brachial plexus injuries.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Trials of acupuncture to treat neuropathic pain have not shown success. Thus, acupuncture is not recommended for treatment of brachial plexopathies. See also the ACOEM Chronic Pain Guideline.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: Acupuncture, Acupuncture Therapy; brachial plexus; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 46 articles in PubMed, 3 in CINAHL, 67 in Cochrane Library, 9160 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

DIATHERMY FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for or against the use of diathermy for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of diathermy for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INFRARED THERAPY FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for or against the use of infrared therapy, for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no recommendation for or against the use of infrared therapy, for the treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANUAL THERAPY FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for or against the use of manual therapy for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of manual therapy for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANIPULATION FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for or against the use of manipulation for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of manipulation for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MASSAGE FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for or against the use of massage for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of massage for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.4.3. ELECTRICAL THERAPIES

HIGH-VOLTAGE GALVANIC STIMULATION FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for or against the use of high-voltage galvanic stimulation for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of high-voltage galvanic stimulation for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

H-WAVE® DEVICE STIMULATION FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for or against the use of H-Wave® Device Stimulation for the treatment of brachial plexopathies.

Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of H-Wave® Device Stimulation for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation,

random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

IONTOPHORESIS FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for or against the use of iontophoresis for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of iontophoresis for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion critera.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MICROCURRENT FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for or against the use of microcurrent for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of microcurrent for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PERCUTANEOUS ELECTRICAL NERVE STIMULATION (PENS) FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for or against the use of percutaneous electrical nerve stimulation (PENS) for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of PENS for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SYMPATHETIC ELECTROTHERAPY FOR BRACHIAL PLEXOPATHIES

No Recommendation

There is no recommendation for or against the use of sympathetic electrotherapy for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TRANSCUTANEOUS ELECTRICAL STIMULATION (TENS) FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for or against the use of transcutaneous electrical stimulation (TENS) for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence and thus there is no recommendation for the use of transcutaneous electrical stimulation (TENS) for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search,

and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PULSED ELECTROMAGNETIC FREQUENCY FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

Not Recommended

Pulsed electromagnetic frequency is not recommended for the treatment of brachial plexopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy and there is evidence suggesting inefficacy for other shoulder disorders. Thus, pulsed electromagnetic frequency is not recommended for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INTERFERENTIAL THERAPY FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

Not Recommended

Interferential therapy is not recommended for the treatment of brachial plexopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy and there is evidence suggesting inefficacy for other shoulder disorders. Thus, interferential therapy is not recommended for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial,

controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.4.4. DEVICES

TAPING FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

Not Recommended

Taping is not recommended for the treatment of brachial plexopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy and there is evidence suggesting inefficacy for other shoulder disorders. Thus, taping is not recommended for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MAGNETS FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

Not Recommended

Magnets are not recommended for the treatment of brachial plexopathies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no quality evidence of efficacy and there is evidence suggesting inefficacy for other shoulder disorders. Thus, magnets are not recommended for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Of the 42 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

PERIPHERAL MAGNETIC STIMULATION FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

No Recommendation

There is no recommendation for peripheral magnetic stimulation for the treatment of brachial plexopathies.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Indications

Patients with inadequate improvements with strengthening exercises, therapy, medications over at least 4 weeks (Khedr et al., 2012).

Benefits

Improvements in pain and function

Harms

Negligible

Frequency/Dose/Duration

10 treatment sessions. The sole trial administered 1 daily treatment for 5 days per week for 2 weeks (Khedr et al., 2012).

Rationale

There is one sham-controlled trial of 10 treatment sessions of peripheral magnetic stimulation for treatment of brachial plexus injuries which suggested significant efficacy, with improvements persisting for 30 days after completion of treatments (Khedr et al., 2012). As there is pilot study suggesting some limited efficacy which has not yet been reproduced, there is no recommendation and further studies are clearly indicated for both rTMS and tDCS. Among those unresponsive to other treatments, this may be a consideration.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed, 27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.4.5. INJECTION THERAPY

Diagnostic injections particularly of the subacromial space, glenohumeral joint and acromioclavicular joint are sometimes performed. However, they are nearly always performed in combination with a therapeutic intervention, such as a glucocorticosteroid injection. Injection with a therapeutic agent is nearly always preferable due to less overall invasiveness with 1 injection rather than 2, as well as the potential to assess the patient both immediately post-injection for diagnostic purposes as well as longer term for therapeutic purposes. See the ACOEM Chronic Pain Guideline.

INJECTIONS FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

Sometimes Recommended

Injections are selectively recommended for combined diagnosis/treatment of brachial plexopathies.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Either brachial plexopathy or a suspicion for brachial plexopathy needing diagnostic confirmation. Among those with brachial plexopathy, injection would typically be reserved for those with moderate to severe symptoms not trending towards resolution.

Benefits

Potential improvement in symptoms

Harms

Symptom exacerbation and/or complication as brachial plexus blocks/injections are risks for brachial plexopathy (Koff, 2008).

Frequency/Dose/Duration

Generally only one injection would be performed, typically combining an anesthetic and glucocorticosteroid. A second injection would only be performed among those with a significant, but incomplete, response to a prior injection. Repeat injections without progressive improvements towards resolution would not be recommended.

Rationale

There is no quality evidence of efficacy and there is evidence suggesting inefficacy for other shoulder disorders. Thus, injections are not recommended for treatment of brachial plexopathies.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: **Injections**; brachial plexus; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 840 articles in PubMed, 52 in CINAHL, 95 in Cochrane Library, 2,300 in Google Scholar, and 0 from other sources†. We considered for inclusion 6 from PubMed, 0 from CINAHL, 0 from Cochrane Library, 0 from Google Scholar, and 0 from other sources. Of the 6 articles considered for inclusion, 4 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.4.6. SURGICAL CONSIDERATIONS

Due to the large variety of injuries involving the brachial plexus, treatment should be individualized, especially in the more severe cases. Immediate surgery has been recommended for patients who sustain penetrating trauma (947). Delayed surgical exploration for non-penetrating trauma cases that fail to resolve sufficiently at 3 to 6 months has also been recommended (148,947). Extensive physical or occupational therapy is recommended for treating cases with limited debility. Some cases are severe and may require surgical exploration and reconstructions (948). Techniques have evolved over time (949,950) to include neurolysis (951), nerve grafting, (951) nerve transfer (neurotization) (952,953,954,955,956), and free muscle transfer (957,958,959,960,961,962,963,964,965). Evidence-based guidance on specific surgical approaches and techniques is not possible at this time as there is a combination of wide array of injuries with a lack of quality trials. Post-operative extensive rehabilitation generally is required.

DIAGNOSTIC ARTHROSCOPY FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

Sometimes Recommended

Diagnostic arthroscopy is recommended for evaluation of carefully select patients with shoulder pain and brachial plexopathies, including subsequent, definitive operative approaches.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

One or more of the following in addition to brachial plexopathies: 1) rotator cuff tear with surgical indications and the expectation that surgical treatment will immediately follow arthroscopy (see below); 2) labral tear with surgical indications (see below); 3) impingement syndrome with surgical indications (see below); 4) glenohumeral instability, 5) recurrent dislocations, 6) labral tears, 7) other moderate or severe shoulder joint pain, acromioclavicular arthritis, or mechanical symptoms with substantially reduced ROM or functional impairment and failure to resolve with at least 1 trial of glucocorticosteroid injection and/or physical or occupational therapy (or exercise program).

Benefits

Diagnostic confirmation and the opportunity for definitive treatment

Harms

Infections, operative complications

Frequency/Dose/Duration

Arthroscopy would rarely be repeated other than for new
Indications

Rationale

Arthroscopy is infrequently needed for brachial plexopathy patients, but may be helpful is performed where there is thought to be a treatable abnormality, rather than merely for diagnostic purposes (Dinnes et al., 2003, Fouse et al., 2007, Abrams, 2006, Baker et al., 2003, Ahmad et al., 2004, Boszotta et al., 2004). If a specific diagnosis is not suggested by and supported by the evaluation with history, physical examination, and imaging studies, then surgical intervention is much less likely to be successful and caution should be taken in doing a purely diagnostic arthroscopy. Arthroscopy is thought to be superior to MRI and ultrasound for diagnosing partial thickness rotator cuff tears. Arthroscopy is invasive, has adverse effects and is high cost. However, in select patients with brachial plexus injuries, arthroscopy may be the best option and is thus recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: brachial plexus, brachial plexus injury; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 1,050 articles in PubMed,

27,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 30 from PubMed, 12 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

SURGERY FOR TREATMENT OF BRACHIAL PLEXUS INJURIES

Sometimes Recommended

Surgery is selectively recommended for treatment of carefully select patients with brachial plexus injuries.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Moderate to severe brachial plexus injuries, generally with supportive studies including at least electrodiagnostic studies and imaging (e.g., MRI or CT myelography). Earlier surgery is generally only indicated when there is clear indication(s) such as completely severed/torn nerve structure. Otherwise, a period of supervised therapy with progressive strengthening is generally indicated, typically requiring several weeks to 3 months depending on severity and demonstrating progressive benefit.

Benefits

Improved function and pain.

Harms

Infections, operative complications, worsened pain

Frequency/Dose/Duration

A second surgical procedure would be rarely indicated.

Rationale

Brachial plexus injuries are highly variable and diverse. Thus, clinical and surgical care must be individualized. There are no quality studies for most surgical procedures used to treat patients with brachial plexus injuries. However, one trial compared single with double fascicular transfer to restore elbow flexion, and found no differences at one year (Martins et al., 2013). One trial compared spinal accessory nerve transfer with intercostal nerve transfer and spinal accessory nerve transfer was superior for better motor power, while intercostal nerve transfer was better for earlier reinnervation of elbow flexion, sensory function, pain and shoulder subluxation (Waikakul S, 1999). Another small pilot study found photobiomodulation added to Oberlin neurotization resulted in superior outcomes

(Foo et al., 2020). Surgery is invasive, as adverse effects and is high cost. However, in select patients with brachial plexus injuries, surgery may be the best option and is thus recommended.

Evidence

A comprehensive literature search was conducted using PubMed, CINAHL, Cochrane Library, and Google Scholar without date limits using the following terms: General Surgery, Surgery, Surgical Repair; brachial plexus; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly, systematic, systematic review, retrospective, prospective studies. We found and reviewed 3,676 articles in PubMed, 753 in CINAHL, 578 in Cochrane Library, 28,600 in Google Scholar, and 0 from other sources†. We considered for inclusion 0 from PubMed, 1 from CINAHL, 1 from Cochrane Library, 2 from Google Scholar, and 0 from other sources. Of the 4 articles considered for inclusion, 3 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

16.4.7. REHABILITATION PROGRAMS

In the absence of quality evidence, it is recommended that brachial plexopathies be treated as neuropathic pain and managed according to the recommendations in the ACOEM Chronic Pain Guideline. Briefly, these recommendations include altering of sleep posture to determine if there is a reduction in pain or other symptoms (Evidence I); aerobic exercise (Evidence A); trial of aquatic therapy for patients who meet referral criteria for supervised exercise therapy and have co-morbidities that preclude effective participation in a weight-bearing physical activity (Evidence I); self-application of low-tech heat therapy (Evidence I); transcutaneous electrical nerve stimulation (TENS) as an adjunct for more efficacious treatments (Evidence C); psychological evaluation as part of evaluation and management of patients with chronic pain in order to assess whether psychological factors will need to be considered and treated as part of treatment plan (Evidence I); cognitive-behavioral therapy as an adjunct to an interdisciplinary program for the treatment of chronic pain (Evidence C); multidisciplinary or interdisciplinary pain rehabilitation program with a focus on behavioral or cognitive-behavioral approaches combined with conditioning exercise for patients with chronic pain who demonstrate partial or total work incapacity due to pain (Evidence I); and work conditioning, work hardening, and early intervention programs (Evidence I).

17. TRIGGER POINTS AND MYOFASCIAL PAIN

17.1. SUMMARY OF RECOMMENDATIONS

The following summary table contains recommendations for evaluating and managing trigger points and myofascial pain from the Evidence-Based Shoulder Disorders Panel. These recommendations are based on critically appraised higher-quality research evidence or, when such evidence was unavailable or inconsistent, on expert consensus as required in ACOEM's Methodology. Recommendations are made under the following categories:

- Strongly Recommended, "A" Level
- Moderately Recommended, "B" Level
- Recommended, "C" Level
- Insufficient – Recommended (Consensus-based), "I" Level
- Insufficient – No Recommendation (Consensus-based), "I" Level
- Insufficient – Not Recommended (Consensus-based), "I" Level
- Not Recommended, "C" Level
- Moderately Not Recommended, "B" Level
- Strongly Not Recommended, "A" Level

17.2. OVERVIEW

"Tender points" is a term used to characterize unusually tender areas of muscle, tendon, or over boney prominences that reproduce the patient's pain when palpated (2282,2283,2284,2285,2286,2287,2288). Trigger points include those points with tenderness, "knots" of muscle or overlying connective tissue, reproduction of the patient's pain when palpated, and elicitation of symptoms distally during palpation (2283,2284,2289,2290). As the diagnostic entity heavily relies upon subjective complaints without purely objective findings, the existence of this condition has been questioned (2291,2292,2293). Work-relatedness of the condition is controversial with an absence of quality data. There are lower quality studies of prevalence or incidence. Lifetime prevalence has been estimated at up to 85% (2294). A survey of pain practitioners estimated a point prevalence of 46.1±27.4% (2294). A cross-sectional study of 9,952 patients found 345 (3.5%) with widespread pain, 4.5% with widespread allodynia, and 2.5% with fibromyalgia (2295).

Patients with muscle tenderness are often given the diagnosis of "myofascial pain." This term was initially developed to characterize patients presenting with muscle tenderness accompanied by trigger points, "taut bands," subtle shortening and weakness of involved muscles, referred symptoms on compression or needling, and postural abnormalities, which were hypothesized as reflective of microtrauma and the generation of excessive force per muscle fiber leading to hypoxia, acidosis, and metabolic depletion. However, multiple aspects of this construct have been disproven; thus, it is now controversial, particularly as it has become increasingly clear that the development of prolonged and disabling muscular pain is often linked to the presence of underlying psychosocial issues that foster inactivity and dependence on palliative passive modalities and pharmacologic interventions (2292,2295,2296,2297,2298,1364,2299). Hence, in the absence of a clear objective anatomic abnormality to differentiate between patients with various forms of muscle pathology, they will be characterized by the descriptive diagnosis of "trigger points."

Most RCTs reviewed herein and in the Fibromyalgia section of the ACOEM Chronic Pain Guideline have not distinguished between tender and trigger points. However, these studies frequently note pain limited to a body region, suggestive of trigger points/myofascial pain. Many RCTs of fibromyalgia have

cited adherence to the American College of Rheumatology case definition, which requires widespread tender points (11 of 18 anatomically defined points) (2300). Approximately 25% of fibromyalgia patients did not satisfy the American College of Rheumatology (ACR) 1990 classification criteria at the time of the study (2300). Quality literature shows that the presentation, risk factors, and management of patients with fibromyalgia differs markedly from other patients with chronic pain. There are RCTs of temporomandibular joint syndrome and facial pain that are classified as addressing myofascial pain syndrome (2301,2302,2303,2304,2305). However, as these conditions are not considered occupational, they are not reviewed in detail. Treatment of fibromyalgia has primarily involved active exercise and medications. Judicious use of injections and acupuncture has also been widely used (see the Fibromyalgia section of the ACOEM Chronic Pain Guideline).

Work-relatedness of trigger points/myofascial pain is controversial as there are no quality epidemiological studies demonstrating a relationship to work. There is epidemiological evidence that certain cases of muscle tension syndrome may be occupational and that disorder may be related to myofascial pain. However, the quality of the studies reported has been suboptimal and true risk factors are not well defined (1363). There is less controversy about work-relatedness of trigger points/myofascial pain when the disorder arises in a body part subject to a clear occupational injury. In practice, a fair number of these cases are determined to be occupational (especially if there is an inciting event, no prior history, and the pain and signs are limited to one body region and not bilateral or disseminated), although supportive epidemiological evidence may be lacking. There is no quality epidemiological evidence that tender points/fibromyalgia (or the closely related conditions involving chronic widespread pain) are occupational conditions (see the ACOEM Chronic Pain Guideline).

The physical examination of a patient with trigger points is typically normal other than for muscle tenderness (and frequent evidence of depression, dysthymia, or other affective disorders in fibromyalgia) (2292,2306). Myofascial pain-related tenderness should be isolated to the body part affected by pain and not be widespread as with fibromyalgia. It also should generally not cross the midline if there was an inciting event to one side of the body. Trigger points and myofascial pain most commonly involve the periscapular muscles on one side of the body. This condition may be indistinguishable from “muscle tension syndrome.” Most patients have an apparent “knot” or tender point in the muscle. That tenderness is perceived as unusually tender to palpation compared with surrounding tissue, as well as compared with other patients’ perceptions. Trigger points require the elicitation of distal symptoms in addition to usually being painful on palpation. The amount of palpatory force used to elicit pain complaints is unclear. The most widely used criteria have used 4kg of force, which are the same criteria used for fibromyalgia (2300). A physical examination of a patient with muscle tenderness also requires palpating other structures that are not involved in the complaints to ascertain the distribution and character of potential tender points and trigger points. Diffuse pain complaints, while needing to be clinically addressed, may be reflective of a chronic pain syndrome and do not require a diagnostic label of myofascial pain or fibromyalgia. There may be some limitation of ROM; however, in general, while active ROM to an extreme may elicit or augment the patient’s pain, the final extent is usually nearly or completely normal among these patients.

Diagnostic testing is generally not required for myofascial pain patients. Occasionally, testing for rheumatological disorders is indicated. This may include erythrocyte sedimentation rate, sedimentation rate, C-reactive protein, anti-rheumatoid factor, anti-nuclear antibodies, anti-Sm, anti-Ro, anti-La for rheumatoid arthritis, lupus, Sjogren syndrome, and evaluation for mixed connective tissue disorder.

17.3. WORK LIMITATIONS

There is no evidence that activity limitations are beneficial for myofascial pain/trigger point patients. It is recommended that patients be maintained at the maximal levels of activity. Those with limitations are recommended to have their limitations gradually reduced. As a regional pain syndrome, patient

catastrophizing and fear avoidant beliefs may also be present and require addressing. Those removed from work may need participatory ergonomic evaluation and behavioral interventions to facilitate earlier return to work (see ACOEM Chronic Pain guideline).

17.4. DIAGNOSTIC RECOMMENDATIONS

17.4.1. X-RAYS

X-RAYS FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Sometimes Recommended

X-rays are selectively recommended for evaluation of acute, subacute, or chronic shoulder pain that includes trigger points/myofascial pain.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Most patients with myofascial pain/trigger points do not require imaging. There are other indications for x-rays including significant trauma, pain without trending towards improvement, impaired use, and those with red flags.

Benefits

Diagnosis of a fracture, calcific tendinitis, osseous abnormality, or otherwise latent medical condition(s).

Harms

Medicalization or worsening of otherwise benign condition; minor radiation exposure.

Frequency/Dose/Duration

Obtaining x-rays once is generally sufficient with two to three views. Imaging of the thoracic and/or cervical spine may sometimes be needed for evaluating myofascial pain/trigger points, particularly for persistent symptoms, lack of response to treatment and other risk factors. For patients with chronic shoulder pain, it may be reasonable to obtain a second set of x-rays later to re-evaluate the patient's condition, particularly if symptoms change.

Rationale

Myofascial pain/trigger points rarely require imaging. However, x-rays may help evaluate patients with myofascial pain/trigger points, primarily to assist with the differential diagnostic possibilities such as tendinoses and arthroses. X-rays are not invasive, low to moderate costly, and have little risk of adverse effects and, therefore, are selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We

found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

17.4.2. DIAGNOSTIC ARTHROSCOPY

DIAGNOSTIC ARTHROSCOPIC SURGERY FOR TRIGGER POINTS AND MYOFASCIAL PAIN

Not Recommended

Arthroscopy is not recommended for the evaluation of trigger points/myofascial pain. There are other indications for arthroscopy.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

Tendons and other tissues have not been shown to be involved in trigger point/myofascial patients. Thus, arthroscopy is not recommended. There are other indications for arthroscopy.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

17.4.3. BONE SCANS

BONE SCANS FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Bone scanning is not recommended for evaluation of trigger points/myofascial pain. There are other indications for bone scanning.

Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

Bones are not believed to be involved in trigger points or myofascial pain syndrome. Thus, imaging with bone scanning is not recommended. There are other indications for bone scanning.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

17.4.4. COMPUTED TOMOGRAPHY

COMPUTED TOMOGRAPHY (CT) FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Computed tomography (CT) is not recommended for evaluation of trigger points/myofascial pain. There are other indications for CT.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

Tendons, bones, and tissues have been shown to be normal in patients with trigger points and myofascial pain syndrome. Thus, imaging with CT is not recommended. There are other indications for CT.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

HELICAL COMPUTED TOMOGRAPHY (CT) FOR TRIGGER POINTS AND MYOFASCIAL PAIN

Not Recommended

Helical computed tomography (CT) is not recommended for the evaluation of trigger points or myofascial pain. There are other indications for helical CT.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

Tendons, bones, and tissues have been shown to be normal in patients with trigger points and myofascial pain syndrome. Thus, imaging with helical CT is not recommended. There are other indications for helical CT.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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17.4.5. LOCAL ANESTHETIC INJECTIONS

See Injection Therapies for Trigger Points.

17.4.6. ELECTROMYOGRAPHY (INCLUDING NERVE CONDUCTION STUDIES)

ELECTROMYOGRAPHY AND NERVE CONDUCTION STUDIES FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Electrodiagnostic studies are not recommended to evaluate trigger points or myofascial pain syndrome. There are other indications for electrodiagnostic studies.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

Trigger points and myofascial pain do not involve abnormalities on electromyography or nerve conduction studies. Thus, electrodiagnostic studies are not recommended. There are other indications for electromyography and nerve conduction studies.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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17.4.7. MAGNETIC RESONANCE IMAGING

MAGNETIC RESONANCE IMAGING FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Magnetic resonance imaging (MRI) is not recommended for the evaluation of trigger points or myofascial pain. There are other indications for MRI.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

Tendons and tissues have been shown to be normal in patients with trigger points and myofascial pain syndrome. Thus, imaging with MRI is not recommended. There are other indications for MRI.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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17.4.8. MAGNETIC RESONANCE ARTHROGRAM

MAGNETIC RESONANCE ARTHROGRAM FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Magnetic resonance arthrography (MRA) is not recommended for trigger points or myofascial pain. There are other indications for MRA.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

Tendons and tissues have been shown to be normal in patients with trigger points and myofascial pain syndrome. Thus, imaging with MRA is not recommended. There are other indications for MRA.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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17.4.9. ULTRASOUND

ULTRASOUND FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Ultrasound is not recommended for use on patients with trigger points or myofascial pain. There are other indications for ultrasound.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

Muscles and tissues have been shown to be normal in patients with trigger points and myofascial pain. Thus, imaging with ultrasound is not recommended. There are other indications for ultrasound.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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17.4.10. SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

SINGLE-PROTON EMISSION COMPUTED TOMOGRAPHY (SPECT) FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Single-proton emission computed tomography (SPECT) is not recommended for the evaluation of patients with trigger points or myofascial pain syndrome.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain, including trigger points or myofascial pain. One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning. Additional studies are needed to determine if SPECT or PET adds

something to the diagnosis, treatment, and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating shoulder disorders, including trigger points and myofascial pain.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

17.4.11. POSITRON EMISSION TOMOGRAPHY (PET)

POSITRON EMISSION TOMOGRAPHY (PET) FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Positron emission tomography (PET) scanning is not recommended for the evaluation of patients with trigger points or myofascial pain syndrome.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Rationale

There is no quality evidence with patient-related outcomes that either SPECT or PET is helpful in improving care of acute, subacute, or chronic shoulder pain, including trigger points or myofascial pain. One study found SPECT helpful in evaluating patients with inflammatory arthropathies, particularly if there are concerns about the SI joints (Hanly, 1993). Some data suggest SPECT may outperform bone scanning. Additional studies are needed to determine if SPECT or PET adds something to the diagnosis, treatment, and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating shoulder disorders, including trigger points and myofascial pain.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

17.5. TREATMENT RECOMMENDATIONS

17.5.1. ACTIVITY MODIFICATION AND EXERCISE

Patients with myofascial pain/trigger points should be maintained as physically active as possible. Patients with limited activity levels require advancement of activity levels and education as inactivity appears detrimental despite the potential for temporary relief of symptoms that may accompany rest or inactivity.

Exercise has been used to treat trigger points/myofascial pain. Most studies are low quality and appear to have emphasized stretching exercises (966,787). However, there are few quality studies that assess which types of exercise and what regimens are most efficacious. Aerobic exercise and strengthening exercises are also believed to be important, although quality studies are limited to support those beliefs (967,968). Aquatic therapy involves the performance of aerobic and/or flexibility and/or strengthening exercises in a pool to minimize the effects of gravity, particularly where reduced weight-bearing status is desirable.

Yoga for the treatment of myofascial pain/trigger points has not been standardized, but tends to include postures that involve isometric muscle activity, stretches, breath control, and relaxation. Traditional yoga also involves rules for personal conduct, sense withdrawal, concentration, meditation, and “self-realization” (969,970), and different versions are practiced. This review focuses on the exercise aspects of yoga and does not endorse nor support spiritual elements or specific religious beliefs (971).

AEROBIC EXERCISE FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Recommended

Aerobic exercise is recommended for treatment of trigger points/myofascial pain, although quality evidence is lacking regarding its efficacy.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Trigger points/myofascial pain. Patients with potential for or with significant cardiac disease should be evaluated prior to institution of vigorous exercises. Follow the American College of Sports Medicine (ACSM) *Guidelines for Exercise Testing and Prescription* for health screening and risk stratification (Pescatello, 2014).

Benefits

Improved pain, resolution of the disorder, improved cardiovascular risks.

Harms

Negligible

Indications for Discontinuation

Development of other disorders

Rationale

One trial found aerobic exercise effective for treatment of trigger points among patients with breast cancer (Cantarero-Villanueva et al., 2012). Another trial found no statistical additive benefit of exercise to acupuncture; however, sample sizes were small and the data trended towards efficacy (Eftekharsadat et al., 2018). There are many other trials where exercises are co-interventions in both groups. Although thought to be a different diagnosis, myofascial pain/trigger points also appear to have similarities with fibromyalgia, for which aerobic exercise is the most important therapeutic intervention (see the ACOEM Chronic Pain Guideline). Aerobic exercise is not invasive, has some evidence of benefits and thus is recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

STRETCHING EXERCISES FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Sometimes Recommended

Stretching exercises are selectively recommended for treatment of trigger points/myofascial pain, accompanied by a loss of joint range of motion, and to attempt to increase overall capacity and activity tolerance. Stretching is recommended to be combined with aerobic exercise.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Myofascial pain/trigger points with reduced range of motion.

Benefits

Improved range of motion, potential to modestly reduce pain

Harms

Negligible

Frequency/Dose/Duration

Stretching exercises may be taught with several appointments and then transitioned to a home exercise program.

Indications for Discontinuation

Restoration of normal ROM, failure to improve or non-compliance

Rationale

There are no quality studies of stretching exercises for myofascial pain/trigger points. Myofascial pain/trigger points appear to have similarities with fibromyalgia, for which stretching exercises are believed to have some modest benefits; however, aerobic exercises appear to be the most important therapeutic intervention, followed by strengthening exercises (see the ACOEM Chronic Pain Guideline). Stretching exercises are not invasive, may have some limited benefits among those with reduced ranges of motion, and thus are selectively recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 4 randomized trials and 0 systematic reviews met the inclusion criteria.

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STRENGTHENING EXERCISES FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Recommended

Strengthening exercises are recommended for treatment of trigger points/myofascial pain to attempt to increase overall capacity and activity tolerance. Strengthening exercises are recommended to be

combined with aerobic exercise. Stretching exercises would be recommended among those with reduced ranges of motion.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Myofascial pain/trigger points

Benefits

Reduced or eliminated pain; improve strength and capacity

Harms

Negligible

Frequency/Dose/Duration

Strengthening exercises may be taught with several appointments and then transitioned to a home exercise program.

Indications for Discontinuation

Development of a strain during treatment course, failure to improve, non-compliance, fully independent in a home exercise program

Rationale

There are no quality studies of strengthening exercises for myofascial pain/trigger points. Myofascial pain/trigger points appear to have similarities with fibromyalgia, for which aerobic exercises are most important, likely followed by strengthening exercises (see ACOEM Chronic Pain Guideline). Strengthening exercises are not invasive, have some benefits among those with reduced ranges of motion, and thus are recommended. They are recommended to be combined with aerobic exercises. They are also recommended to be combined with stretching exercises among those with significant reductions in ranges of motion.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

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and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INCLUSION OF FEAR AVOIDANCE BELIEF TRAINING FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Recommended

Inclusion of fear avoidance belief training (FABT) during the course of treatment with either a supervised or home exercise program is recommended.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Myofascial pain/trigger points

Benefits

Improved compliance with exercises and activity advancements; reduced or eliminated pain; improved capacity

Harms

Negligible

Frequency/Dose/Duration

FABT is typically taught over several appointments along with institution of a structured exercise program and advancements of activities.

Rationale

Fear avoidance belief training (FABT) is believed to be quite important in the management of myofascial pain/trigger points. Inclusion of FABT principles in the course of exercise training or supervision is thus highly desirable. Inclusion of FABT principles also strengthens the patient's education about these problems that should be a concordant message among all members of the team treating the patient.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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AQUATIC THERAPY FOR MYOFASCIAL PAIN OR TRIGGER POINTS

Sometimes Recommended

Aquatic therapy is selectively recommended for treatment of trigger points/myofascial pain.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Moderate

Indications

Trigger points/myofascial pain patients who hare a contraindication for traditional aerobic exercise and/or a strong belief and rationale that compliance would be significantly higher with aquatic therapy than progressive walking/aerobic exercises which are typically much easier to schedule/accomplish. Patients with potential for or with significant cardiac disease should be evaluated prior to institution of vigorous exercises. Follow ACSM's Guidelines for Exercise Testing and Prescription (Pescatello, 2014) for health screening and risk stratification.

Benefits

Improved pain, resolution of the disorder, improved cardiovascular risks.

Harms

Negligible

Frequency/Dose/Duration

A structured, progressive aquatic program (at least 4 times a week) at an intensity to reach at least 60% of predicted maximum heart rate is recommended. Activity is recommended to be gradually increased over days to weeks, beginning at 30 minutes/day and increasing to 45 minutes/day.

Indications for Discontinuation

Development of other disorders.

Rationale

There are no quality studies of aquatic exercise for myofascial pain/trigger points. Myofascial pain/trigger points appear to have similarities with fibromyalgia for which aerobic exercises are the most important therapeutic intervention (see the ACOEM Chronic Pain Guideline). Aquatic exercise is not invasive, is believed to have benefits due to its aerobic benefits, and thus is efficacious. It is selectively recommended among those with a strong belief and rationale that compliance would be significantly higher with aquatic therapy than progressive walking or aerobic exercises, which are typically much easier to schedule and accomplish.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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YOGA FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for or against the use of yoga for treatment of trigger points/myofascial pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials of yoga for myofascial pain/trigger points. There is moderate-quality evidence of effectiveness of yoga for the treatment of chronic LBP (Williams et al., 2005, Sherman et al., 2005, Galantino et al., 2004). Yoga is not invasive, has low potential for adverse effects, and is low cost. Aerobic and strengthening exercises are believed to be important for treatment of myofascial pain/trigger points, thus there is no recommendation for yoga in the absence of quality evidence of efficacy.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

17.5.2. HOT AND COLD THERAPIES

Cold or cryotherapies have sometimes been used for treatment of trigger points/myofascial pain. There are many forms of heat therapy for treatment of musculoskeletal pain, including hot packs, moist hot packs, sauna, warm baths, infrared, diathermy, and ultrasound. Many of these have been utilized for treatment of patients with myofascial pain/trigger points.

Diathermy is a heat treatment that has been used clinically to heat tissue. There are two forms of diathermy – short wave and microwave. (High-dose diathermy is also used to coagulate tissue.) Proponents believe diathermy penetrates deeper than hot packs or heating pads and stimulates healing. Infrared therapy is a heat treatment created by various devices producing electromagnetic radiation in the infrared spectrum.

HOME USE OF CRYOTHERAPIES FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for or against the home use of cryotherapies for trigger points/myofascial pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials. Self-applications of cryotherapies using towels or reusable devices are not invasive, generally without complications and do not have any appreciable costs. As there is no evidence of efficacy, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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SELF-APPLICATION OF HEAT THERAPY FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for or against self-application of heat for treatment of trigger points/myofascial pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials. Self-applications of heat is not invasive, generally without complications, and do not have any appreciable costs. As there is no evidence of efficacy, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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DIATHERMY FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Diathermy is not recommended for treatment of trigger points/myofascial pain.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

Diathermy has not been shown to be more effective than placebo diathermy for treatment of multiple conditions (Sweetman et al., 1993, Koes et al., 1992, Koes et al., 1992, Koes et al., 1993, Koes et al., 1992), although trigger points/myofascial pain have not been directly studied. Diathermy is not invasive, has low adverse effects, is moderately costly, and lacks evidence of efficacy. Thus, it is not recommended for treatment of trigger points/myofascial pain.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder,

myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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INFRARED THERAPY FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Provider-based infrared therapy is not recommended for trigger points/myofascial pain.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials on infrared therapy for trigger points/myofascial pain. Infrared is not invasive, has low potential for adverse effects, but is of moderate cost in aggregate and thus is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

17.5.3. DEVICES

Taping and kinesiotaping are used on the extremities, particularly in sports settings. Taping (white athletic taping, cotton mesh adhesive tape often over gauze) is intended to stabilize and support while restricting ROM; thus, it is used for treatment and preventive purposes (388,389,390,391). Taping has been used to treat myofascial pain. It is often utilized immediately prior to an activity and then removed, or the cotton mesh may be applied and removed after hours of use. Kinesiotaping (thinner,

elastic tape) is also intended for treatment, including pain relief; however, it allows full ROM in contrast with traditional taping (390,392,393,394,396,397,398,385,384). Kinesiotaping is proprietary; proponents believe the tape should be applied in specific patterns and may or may not be stretched depending on the injury. Regardless, all types of taping are utilized to attempt to treat musculoskeletal disorders. Difficulty with tolerating the various types of tape may be problematic for some patients.

High-intensity magnetic stimulation purportedly causes depolarization of nerves and has been found to result in an antinociceptive effect in rats (399). Electromagnetic fields have been known to increase osteoblastic activity. Therefore, proponents believe that magnetic fields have therapeutic value in the treatment of MSDs.

MECHANICAL MASSAGE DEVICES FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

The use of mechanical massage devices to administer massage is not recommended for trigger points/myofascial pain.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality studies. Massage devices have no significant adverse effects, are moderate to high cost, and thus are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 12 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

TAPING AND KINESIOTAPING FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Taping and kinesiotaping are not recommended for the treatment of trigger points/myofascial pain.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials of treatment for myofascial pain/trigger points. There is one high-quality trial of kinesiotaping for treatment of shoulder pain, of short-term duration that failed to show improvements in pain (Thelen et al., 2008); there are no other quality trials. Kinesiotaping and taping have not been shown to have sustained efficacy. As use and movement are thought to be helpful for treating trigger points/ myofascial pain, the rationale for taping the shoulder and back for myofascial pain/trigger points is inapparent. These interventions are not invasive. Taping and kinesiotaping have potential adverse effects from intolerance of among those who do not tolerate it or the adhesives, but they are generally minor. When the fees for both the tape and its application are considered, taping is costly, especially since there are alternative interventions that have been shown to be effective. As there is no quality evidence of durable effects, and these interventions are counter to increasing activity, they are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MAGNETS AND MAGNETIC STIMULATION FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Magnets and magnetic stimulation are not recommended for the treatment of trigger points or myofascial pain.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is no significant evidence base from which to draw conclusions on the utility of magnets as a treatment of these patients. Magnets have been shown to be ineffective for treatment of other MSDs including back pain and plantar fasciitis (see the ACOEM Low Back Disorders and Ankle and Foot Disorders Guidelines). Other treatments have demonstrated efficacy. Magnets are not invasive, have no adverse effects, and are low cost. However, without evidence of efficacy, they are not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

17.5.4. ALLIED HEALTH INTERVENTIONS

Acupuncture has been used for treatment of chronic pain patients, including patients with trigger points or myofascial pain (966). Therapeutic ultrasound has been used for treatment of myofascial pain/trigger points (787). Low-level laser treatment usually involves laser energy that does not induce significant heating. It is theorized that the mechanism of action is through photoactivation of the oxidative chain (284).

Manipulation and mobilization are two types of manual therapy that have been used widely to treat musculoskeletal disorders, although mostly for spine disorders (972,973,974,975,976,977,978,979,980,981,982) or in patients with shoulder pain not of trigger points/myofascial pain origin (983,984,985). Massage is a commonly used treatment for chronic muscular pain administered by providers as well as others. It is sometimes referred to as soft tissue mobilization. A complicating factor in this review is the varying methods of massage that are employed, including in more recent trials described below.

ACUPUNCTURE FOR CHRONIC TRIGGER POINTS/MYOFASCIAL PAIN

Recommended

Acupuncture is recommended for select use in chronic moderate to severe chronic trigger points/myofascial pain as an adjunct to more efficacious treatments.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Moderate to severe chronic trigger points/myofascial pain not adequately confrolled after NSAIDs, aerobic and strengthening exercises, and a trial of dry needling or injection(s) with bupivacaine. Patients should also be prescribed, and be compliant with, progressive aerobic and strengthening exercises while undergoing acupuncture.

Benefits

Modest improvement in pain

Harms

Negligible other than deep needling, which can puncture or lacerate deep viscera in inexperienced hands

Frequency/Dose/Duration

A limited course of 6 sessions as an adjunct to a conditioning program that has both graded aerobic exercise and strengthening and stretching exercises (if range of motion decrements) for treatment of trigger points/myofascial pain during which time there are clear objective and functional goals that are to be achieved. Additional subsequent appointments may be supportable if there are functional benefits that have not reached a demonstrable plateau.

Indications for Discontinuation

Resolution, intolerance, non-compliance with acupuncture, as well as non-compliance with aerobic and strengthening and stretching exercises

Rationale

There are few quality studies evaluating acupuncture for the treatment of tender and trigger points; they tend to have significant design flaws which limit the strength of conclusions. Efficacy of acupuncture for this indication is suggested by the highest quality available study that has a non-acupuncture comparison group (Edwards et al., 2003), yet that study has significant flaws. Considering acupuncture's efficacy in treating chronic low back pain (LBP), efficacy for this indication would not be surprising. For LBP, there is no quality evidence suggesting that one type of acupuncture is superior to another (e.g., Chinese vs. Japanese). High-quality studies with sizable populations and long follow-up periods are needed.

Acupuncture is minimally invasive, has low adverse effects, and is moderately costly. Acupuncture is recommended to assist in increasing functional activity levels more rapidly and the primary attention should remain on the conditioning program. In patients not involved in a conditioning program, or who are non-compliant with graded increases in activity levels, this intervention is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 7 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search,

and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ISCHEMIC COMPRESSION THERAPY FOR MYOFASCIAL PAIN SYNDROME

No Recommendation

There is no recommendation for ischemic compression therapy for myofascial pain syndrome.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are two RCTs and the results conflict. One crossover RCT suggested efficacy (Hains et al., 2010), while another suggested a lack of efficacy although there were multiple co-interventions (Akbaba et al., 2019). Because results conflict, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

ULTRASOUND FOR THE TREATMENT OF TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Ultrasound is not recommended for treatment of trigger points/myofascial pain.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Moderate

Rationale

One quality trial found ultrasound ineffective for treatment of trigger points/myofascial pain (Gam et al., 1998). The other trial compared two different active ultrasound techniques for acute pain of less than 2 weeks duration, raising questions about applicability to the typical trigger point/myofascial pain patient (Majlesi et al., 2004). Ultrasound is not invasive, has few adverse effects, but is moderately costly and appears ineffective; thus, it is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

LOW-LEVEL LASER THERAPY FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for or against the use of low-level laser therapy for the treatment of trigger points/myofascial pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are quality trials for treatment of trigger points/myofascial pain, however different lasers and treatment regimens have been used and no long-term results have been reported. Quality evidence is conflicting (Gur et al., 2004, Dundar et al., 2007, Altan et al., 2005), with the highest quality studies finding no benefit (Dundar et al., 2007, Altan et al., 2005). The quality study that showed benefit found minimal difference between the treatment groups (Gur et al., 2004). Low-level laser therapy is not invasive, is unlikely to have significant adverse effects, but in aggregate is moderate to high cost. Longer-term evaluation, utilization of objective measures, and standardization of the treatment regimens is required in addition to consistent, quality evidence of efficacy. Thus, there is no recommendation for or against low-level laser therapy for treating patients with trigger points or myofascial pain.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 3 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MANIPULATION AND MOBILIZATION FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for or against the use of manipulation and mobilization for trigger points or myofascial pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One study of the ischemic compression of trigger points failed to find efficacy in comparison with a standardized treatment program (Akbaba et al., 2019). Another trial comparing combinations of manual compression of trigger points, manual stretching, intermittent cold, and stretching compared with a wait-listed control reported some improvements (Bron et al., 2011). Another trial of dry needling compared to manual pressure technique reported comparable results, suggesting equivalent efficacy (De Meulemeester et al., 2017). Another trial found manual compression therapy to be superior to compression therapy in other locations (Hains et al., 2010). Another trial of diadynamic currents and manual therapy found the combination superior to the individual treatments (Gomes et al., 2018). These studies are small, heterogenous, and have strong risks of biases. Manipulation and mobilization are not invasive, have some adverse effects, and are moderately costly depending on numbers of treatments. In the absence of clear evidence of efficacy for patients specifically with trigger points/myofascial pain, there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 6 randomized trials and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MASSAGE FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Recommended

Massage is recommended for select use in patients with trigger points/myofascial pain as an adjunct to active treatments consisting primarily of a graded aerobic and strengthening exercise program.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence Low

Indications

Moderate to severe chronic pain associated with trigger points/myofascial pain without underlying serious pathology as an adjunct to a conditioning program that has both graded aerobic exercises, strengthening, and stretching exercises. Massage is recommended to assist in increasing functional activity levels more rapidly and the primary attention should remain on the conditioning program. In those not involved in a conditioning program, or who are non-compliant with graded increases in activity levels, this intervention is not recommended.

Benefits

Modest improvement in pain

Harms

Negligible

Frequency/Dose/Duration

A limited course as an adjunct to a conditioning program that has both graded aerobic exercise and strengthening and stretching exercises (if range of motion decrements) for treatment of trigger points/myofascial pain during which time there are clear objective and functional goals that are to be achieved. Three to 5 visits; if ongoing objective improvement, up to 8 to 10 additional treatments appropriate. In unusual circumstances involving more severe cases with ongoing transitions to an active treatment program and with evidence of improvement, an additional 3 to 5 treatments may be indicated.

Indications for Discontinuation

Resolution, intolerance, non-adherence with massage appointments, as well as non-adherence with aerobic and strengthening and stretching exercises

Rationale

Massage is a commonly used treatment for musculoskeletal pain (Cen et al., 2003), but few studies have evaluated disorders other than LBP (Preyde, 2000, Kalauokalani et al., 2001, Melzack et al., 1983) and there are few quality studies for treatment of trigger points/ myofascial pain. One study of myofascial trigger points was negative (Gam et al., 1998). Another of neck pain was negative (Irnich et al., 2001). Thus, the literature suggests massage is a weakly effective treatment that is not as effective as active exercise or acupuncture. Massage is not invasive, has low risk of adverse effects aside from short-term pain (Cherkin et al., 2001), and is moderately costly. It is recommended for treatment of chronic pain as an adjunct to a conditioning program.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MYOFASCIAL RELEASE FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for myofascial release for trigger points/myofascial pain. It may be used as an option in place of trigger point injections (not to exceed 4 to 6 treatments).
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

Myofascial release has not been shown to be effective in quality studies. It is not invasive, but the treatment is passive and moderately costly. There are active interventions shown to be efficacious, and thus it is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

17.5.5. ELECTRICAL THERAPIES

There are multiple forms of electrical therapies used to treat musculoskeletal pain. These include transcutaneous electrical stimulation (TENS), percutaneous electrical nerve stimulation (PENS), H-Wave® Device stimulation, sympathetic electrotherapy, microcurrent, and interferential. The mechanism(s) of action, if any, are unclear.

High voltage galvanic, H-wave stimulation, interferential therapy, microcurrent, and iontophoresis are electrical therapies. They are commonly believed to be efficacious through distraction or through promoting healing. Iontophoresis additionally attempts to transdermally deliver medications, typically glucocorticosteroids NSAIDs, lidocaine, etc., through the dermis to the target tissue. Percutaneous electrical nerve stimulation involves inserting needles to a depth of 1 to 4 centimeters around a nerve serving a painful area. The techniques described in available studies differ.

Transcutaneous electrical nerve stimulation (TENS) is used to attempt to control pain through electrical stimulation delivered by pads placed on the surface of the skin for the treatment of many painful conditions, including both non-inflammatory and inflammatory disorders (986,987,988,989,990). Either a low-intensity prolonged (30 plus minutes) stimulation through an active electrode over the painful area or a higher intensity over the painful area for a brief (15 to 30 minutes) amount of time (commonly referred to as hyperstimulation analgesia) are the two most common treatment protocols (991). There are reports that both low- and high-frequency TENS stimulate the endogenous opioid system, but the type of response is dependent on frequency of stimulation. Through these mechanisms, it is theorized that there may be a mechanism for increased physical activity in TENS users (992). Low intensity, high-frequency stimulation is generally 80 to 200Hz, whereas brief higher intensity low frequency is generally 4 to 8Hz. Some studies do not report the frequency of the stimulation.

HIGH-VOLTAGE GALVANIC THERAPY FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for or against high-voltage galvanic therapy for the treatment of trigger points/myofascial pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials for these electrical therapies. Electrical therapies are not invasive, have low adverse effects, and are moderately costly in aggregate. As there is no quality evidence, there is no recommendation for or against these treatments.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

H-WAVE® DEVICE STIMULATION FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for or against H-wave® Device Stimulation for the treatment of trigger points/myofascial pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials for these electrical therapies. Electrical therapies are not invasive, have low adverse effects and are moderately costly in aggregate. As there is no quality evidence, there is no recommendation for or against these treatments.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

INTERFERENTIAL THERAPY FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for or against interferential therapy for the treatment of trigger points/myofascial pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials for these electrical therapies. Electrical therapies are not invasive, have low adverse effects and are moderately costly in aggregate. As there is no quality evidence, there is no recommendation for or against these treatments.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

MICROCURRENT FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for or against microcurrent for the treatment of trigger points/myofascial pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials for these electrical therapies. Electrical therapies are not invasive, have low adverse effects and are moderately costly in aggregate. As there is no quality evidence, there is no recommendation for or against these treatments.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

† The results for databases are sorted by relevancy based on customized search term algorithms. Algorithms for each database determine relevancy. The first 100 articles are reviewed in each search, and if relevant literature appears in the first 100 articles, we review an additional 100 articles. If relevant articles appear in these additional 100 articles, we then review another 100. We continue

this pattern of review until we review a batch of 100 articles that contains no relevant literature. When this happens then the remaining articles are not reviewed due to a lack of relevancy.

IONTOPHORESIS FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for or against iontophoresis for the treatment of trigger points/myofascial pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There are no quality trials for these electrical therapies. Electrical therapies are not invasive, have low adverse effects and are moderately costly in aggregate. As there is no quality evidence, there is no recommendation for or against these treatments.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

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PERCUTANEOUS ELECTRICAL NERVE STIMULATION (PENS) FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Percutaneous electrical nerve stimulation (PENS) is not recommended for treating trigger points/myofascial pain.
Strength of evidence Not Recommended, Insufficient Evidence (I)
Level of confidence Low

Rationale

PENS has been evaluated in small scale, short-term studies of low back pain but no quality studies have been reported for treatment of trigger points/myofascial pain. PENS is minimally invasive and no significant adverse effects have been reported (although most articles failed to address complications). However, it is high cost in aggregate and with absence of evidence of efficacy, it is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 2 randomized trials and 0 systematic reviews met the inclusion criteria.

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TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) FOR TRIGGER POINTS OR MYOFASCIAL PAIN

No Recommendation

There is no recommendation for or against use of transcutaneous electrical nerve stimulation (TENS) for treatment of trigger points/myofascial pain.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

There is one trial of acupuncture-like TENS compared with conventional TENS and reported that both treatments were superior to a sham TENS, however the baseline DASH scores are markedly different (Ebadi et al., 2021). There are no quality studies for trigger points/myofascial pain (Hsueh et al., 1997, Chee et al., 1986). Most of the quality evidence addresses treatment of spine pain (Oosterhof et al., 2008, Oosterhof et al., 2006, Koke et al., 2004, Vitiello et al., 2007, Bloodworth et al., 2004, Deyo et al., 1990, Jarzem et al., 2005). TENS is not invasive, has no significant adverse effects, and is moderately costly, but there is no quality evidence of efficacy for trigger points/myofascial pain. Other treatments have documented efficacy; thus, there is no recommendation for or against the use of TENS.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

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NEUROMODULATION (TDCS) FOR MYOFASCIAL PAIN SYNDROME

No Recommendation

There is no recommendation for neuromodulation (tDCS) for myofascial pain syndrome.
Strength of evidence No Recommendation, Insufficient Evidence (I)
Level of confidence Low

Rationale

One short-term RCT with tiny sample sizes found no significant between group differences that included an attempted sham (Choi et al., 2014) and thus there is no recommendation.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 1 randomized trial and 0 systematic reviews met the inclusion criteria.

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17.5.6. INJECTION THERAPIES

Injections into the muscle “knots” or clinically tender spots have typically consisted of an anesthetic with or without glucocorticoid (2307,2308). Botulinum injections have antinociceptive properties and have been used to produce muscle paresis (502,2309,2310,2311). Adherents believe that this pharmacologically induced resting of the muscle is useful as a treatment for a number of MSDs. However, these injections have primarily been used for numerous non-occupational conditions such as cervical dystonia (2312,2313,2314,2315,2316,2317,2318,2319,2320,2321,2322,2323,2324,2325,2326,2327,2328), torticollis (2329,2330,2331,2332,2333,2334,2335), strabismus, migraine prophylaxis (2336), blepharospasm (2337), neuropathic pain after neck dissection (2338), and severe primary axillary

hyperhidrosis (see ACOEM Chronic Pain Guideline) (2337,2339). They have also been used to treat upper back and myofascial pain (502,2340,2341). Botulinum injections have been used to treat trigger points and myofascial pain. These injections are thought to directly treat a taut muscle band and to have analgesic properties (2309,2310,2311).

TRIGGER POINT INJECTIONS AND DRY NEEDLING USING LOCAL ANESTHETIC

Recommended

Trigger point injections consisting solely of a topical anesthetic such as bupivacaine are recommended as a secondary or tertiary option for subacute or chronic trigger points that are not resolving. Dry needling is an acceptable alternative. Adjunctive use of a glucocorticosteroid is not recommended.
Strength of evidence Recommended, Evidence (C)
Level of confidence Low

Indications

Persistent moderate to severe trigger points not resolving with more conservative means (e.g., NSAIDs, progressive aerobic exercises, and other exercises). Trigger points proposed for injection should also be shown to be persistent in one anatomic location prior to performing an injection. Patients should also be prescribed, and be compliant with, progressive aerobic and strengthening exercises.

Benefits

Modest improvements in pain

Harms

Medicalization, hematomas, low risk of infection

Frequency/Dose/Duration

Up to 4 injections a session with a follow-up appointment to assess subjective and objective measures of efficacy. Injections should not be repeated more than every 3 to 4 weeks (Ojala et al., 2006). If results are not satisfactory after the first injection, a second may be attempted. If there are not subjective and objective improvements at that point, further injections are not recommended (Ojala et al., 2006). In general, up to 3 sets of injections are recommended to allow sufficient time to (re)establish a program of active therapy or identify modalities for successful self-application. Repeated injections should be linked to subjective and objective functional improvements. The use of therapeutic injections without participation in an active exercise (both progressive aerobic and strengthening) or rehabilitation program is not recommended (Kamanli et al., 2005, Wheeler et al., 2001).

Indications for Discontinuation

Resolution, intolerance, completion of 2 set(s) of injections without materially affecting the condition.

Rationale

The literature on this subject is heterogeneous. Study designs, health outcomes assessed, interventions performed all differ widely across these studies (Byrn, 1993, Sonne et al., 1985). The

highest quality study that addressed a typical patient with periscapular or cervical tender points or trigger points found no difference between bupivacaine and botulinum other than much lower cost for bupivacaine (Graboski et al., 2005). The next highest quality study of typical patients suggests anesthetic injections were superior to saline (Hameroff et al., 1981). There are no long-term studies or follow-up to suggest enduring benefits of these injections. There is no evidence that a steroid is required for efficacy of these injections, particularly those that are tender point injections (Porta, 2000). Considering glucocorticosteroids also have adverse effects, use of glucocorticosteroids in these injections is not recommended.

A study evaluated injection with 1% lidocaine versus lidocaine/water mixture and suggested that the lidocaine/water mixture had less injection site pain and better pain outcomes at 14 days after injection (Iwama et al., 2000). However, another report by the same author found no differences among 4 injection mixtures (Iwama et al., 2001). A trial comparing transcranial direct current stimulation and trigger point injection with sham stimulation found few differences over 5 days (Choi et al., 2014). A pilot trial of deep dry needling reported some improvements after one treatment (Calvo-Lobo et al., 2017). Another trial of dry needling compared to manual pressure technique reported comparable results, suggesting equivalent (in)efficacy (De Meulemeester et al., 2017). These injections are invasive, have rare adverse effects, (Garvey et al., 1989) and are moderately costly depending on number. An injectable anesthetic, typically either lidocaine or bupivacaine are recommended (Kamanli et al., 2005, Iwama et al., 2000). There are no studies evaluating them on a longer term basis, though there are studies suggesting benefits lasting up to 14 days (Collee et al., 1991). Acupuncture is an alternative to these injections.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 9 randomized trials and 0 systematic reviews met the inclusion criteria.

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TRIGGER POINT INJECTIONS USING GLUCOCORTICOSTEROIDS

Not Recommended

Glucocorticosteroids are not recommended for use in trigger point injections.
Strength of evidence Not Recommended, Evidence (C)
Level of confidence Low

Indications

Rationale

Quality studies suggest there is no benefit from including a glucocorticosteroid with these injections (Porta, 2000). Considering glucocorticosteroids also have adverse effects, use of glucocorticosteroids in these injections is not recommended.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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BOTULINUM INJECTIONS FOR TRIGGER POINTS OR MYOFASCIAL PAIN

Not Recommended

Botulinum injections are moderately not recommended for treating trigger points/myofascial pain.
Strength of evidence Moderately Not Recommended, Evidence (B)
Level of confidence Moderate

Rationale

Botulinum toxin A to treat trigger points/myofascial pain has been evaluated in multiple placebo-controlled quality studies with nearly all studies finding a lack of benefit. Within this body of evidence, there are five high-quality studies with the four largest studies all finding a lack of clear benefit (Ojala et al., 2006, Gobel et al., 2006, Ferrante et al., 2005, Lew et al., 2008). One study suggested some modest results compared with saline injection (Gobel et al., 2006), but this study utilized a more severely affected patient population, suggested low magnitude of benefit, and the benefit was eliminated by the end of the trial. Moderate-quality studies also failed to find benefits from botulinum injection (Ojala et al., 2006, Qerama et al., 2006). There is one study favoring botulinum (Porta, 2000), but the control group utilized a depot preparation of methylprednisolone. Botulinum does not appear superior to bupivacaine (Graboski et al., 2005), and the latter has a much lower adverse effect profile.

Botulinum injections are invasive, have adverse effects that include fatalities (Li et al., 2005), and are costly. There are no quality studies available with long-term follow-up (Argoff, 2003, Difazio et al., 2002). These injections induce weakness, yet many of the most successful interventions build strength

and/or endurance. With quality evidence suggesting a lack of meaningful benefits, botulinum injections are moderately not recommended for treatment of trigger points/myofascial pain.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Of the 23 articles considered for inclusion, 11 randomized trials and 0 systematic reviews met the inclusion criteria.

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17.5.7. SURGICAL CONSIDERATIONS

There are no surgical indications for trigger points/myofascial pain. There are indications for surgery for other disorders.

17.5.8. BEHAVIORAL AND PSYCHOLOGICAL INTERVENTIONS

Psychological and behavioral factors are key components of chronic nonmalignant pain conditions. Evaluation of patients with chronic trigger points/myofascial pain or pain that is not resolving as expected for psychological factors is frequently utilized (see ACOEM Chronic Pain Guideline for indications for cognitive behavioral therapy).

PSYCHOLOGICAL EVALUATION FOR CHRONIC TRIGGER POINTS OR MYOFASCIAL PAIN

Recommended

A psychological evaluation is recommended as part of the evaluation and management of patients with chronic trigger points/myofascial pain to assess whether psychological factors will need to be considered and treated as part of the overall treatment plan.
Strength of evidence Recommended, Insufficient Evidence (I)
Level of confidence High

Indications

Chronic, moderate to severe trigger points/myofascial pain, especially if there is ongoing disability or need of treatment. Select patients with subacute moderate to severe trigger points/myofascial pain are also candidates, particularly if not trending towards resolution and/or with debility.

Benefits

Identification of contributing factors

Harms

Negligible

Rationale

There are no quality trials. Psychological assessments are routinely accomplished to evaluate for the existence and impacts of psychological factors. Evaluations are generally low to moderate cost and can help identify contributing factors, and thereby suggest treatment options. Thus, psychological evaluation is recommended particularly for chronic, moderate to severe trigger points/myofascial pain, especially if there is ongoing disability or need of treatment. Select patients with subacute moderate to severe trigger points/myofascial pain are also candidates, particularly if not trending towards resolution and/or with debility.

Evidence

A comprehensive literature search was conducted using PubMed and Google Scholar between 2013 to 2022 using the following terms: myofascial pain syndromes shoulder, trigger points shoulder, myofascial pain shoulder; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random*, randomized, randomization, randomly. We found and reviewed 31 articles in PubMed, 15,400 in Google Scholar, and 0 from other sources†. We considered for inclusion 17 from PubMed, 6 from Google Scholar, and 0 from other sources. Zero articles met the inclusion criteria.

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17.5.9. FOLLOW-UP VISITS

Patients with trigger points/myofascial pain generally require at least a few to many follow-up appointments depending on severity, persistence, response to therapy, fear avoidant beliefs, and compliance with treatments including exercises. Follow-up appointments are required every 1 to 4 weeks until resolution or an end-of-improvement plateau is reached.

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REFERENCES

1. Mannion, A. F., Muntener, M., Taimela, S., Dvorak, J. Comparison of three active therapies for chronic low back pain: results of a randomized clinical trial with one-year follow-up. *Rheumatology*; Jul 2001.

2. Kankaanpaa, M., Taimela, S., Airaksinen, O., Hanninen, O. The efficacy of active rehabilitation in chronic low back pain. Effect on pain intensity, self-experienced disability, and lumbar fatigability. *Spine (Phila Pa 1976)*; May 15 1999.

3. Cohen, I., Rainville, J. Aggressive exercise as treatment for chronic low back pain. *Sports Med*; 2002.

4. Danielsen, J. M., Johnsen, R., Kibsgaard, S. K., Hellevik, E. Early aggressive exercise for postoperative rehabilitation after discectomy. *Spine*; Apr 15 2000.

5. Gross, D. P., Battié, M. C. Does functional capacity evaluation predict recovery in workers' compensation claimants with upper extremity disorders? *Occup Environ Med*; Jun 2006.

6. Hahne, A. J., Ford, J. J. Functional restoration for a chronic lumbar disk extrusion with associated radiculopathy. *Phys Ther*; Dec 2006.

7. Poiraudeau, S., Rannou, F., Revel, M. Functional restoration programs for low back pain: a systematic review. *Ann Readapt Med Phys*; Jul 2007.

8. Khan, K. M., Cook, J. L., Taunton, J. E., Bonar, F. Overuse tendinosis, not tendinitis part 1: a new paradigm for a difficult clinical problem. *Phys Sportsmed*; May 2000.

9. Constant, C. R., Murley, A. H. A clinical method of functional assessment of the shoulder. *Clin Orthop Relat Res*; Jan 1987.

10. Williams, G. N., Gangel, T. J., Arciero, R. A., Uhorchak, J. M., Taylor, D. C. Comparison of the single assessment numeric evaluation method and two shoulder rating scales. Outcomes measures after shoulder surgery. *Am J Sports MEd*; Mar-Apr 1999.

11. Godfrey, J., Hamman, R., Lowenstein, S., Briggs, K., Kocher, M. Reliability, validity, and responsiveness of the simple shoulder test: psychometric properties by age and injury type. *J Shoulder Elbow Surg*; May-Jun 2007.

12. Beaton, D. E., Richards, R. R. Measuring function of the shoulder. A cross-sectional comparison of five questionnaires. *J Bone Joint Surg Am*; Jun 1996.

13. Beaton, D., Richards, R. R. Assessing the reliability and responsiveness of 5 shoulder questionnaires. *J Shoulder Elbow Surg*; Nov-Dec 1998.

14. Beaton, D. E., Katz, J. N., Fossel, A. H., Wright, J. G., Tarasuk, V., Bombardier, C. Measuring the whole or the parts? Validity, reliability, and responsiveness of the Disabilities of the Arm, Shoulder and Hand outcome measure in different regions of the upper extremity. *J Hand Ther*; Apr-Jun 2001.

15. Beaton, D. E., Schemitsch, E. Measures of health-related quality of life and physical function. *Clin Orthop Relat Res*; Aug 2003.

16. Bot, S. D., Terwee, C. B., van der Windt, D. A., Bouter, L. M., Dekker, J., de Vet, H. C. Clinimetric evaluation of shoulder disability questionnaires: a systematic review of the literature. *Ann Rheum Dis*; Apr 2004.

17. Cook, K. F., Gartsman, G. M., Roddey, T. S., Olson, S. L. The measurement level and trait-specific reliability of 4 scales of shoulder functioning: an empiric investigation. *Arch Phys Med Rehabil*; Nov 2001.

18. Kirkley, A., Litchfield, R., Thain, L., Spouge, A. Agreement between magnetic resonance imaging and arthroscopic evaluation of the shoulder joint in primary anterior dislocation of the shoulder. *Clin J Sport Med*; May 2003.

19. Kocher, M. S., Horan, M. P., Briggs, K. K., Richardson, T. R., O'Holleran, J., Hawkins, R. J. Reliability, validity, and responsiveness of the American Shoulder and Elbow Surgeons subjective shoulder scale in patients with shoulder instability, rotator cuff disease, and glenohumeral arthritis. *J Bone Joint Surg Am*; Sep 2005.

20. L'Insalata, J. C., Warren, R. F., Cohen, S. B., Altchek, D. W., Peterson, M. G. A self-administered questionnaire for assessment of symptoms and function of the shoulder. *J Bone Joint Surg Am*; May 1997.

21. Lippitt, SB, Harryman, DT, Matsen, FA III. A practical tool for evaluating function: The simple shoulder test. *The Shoulder: A Balance of Mobility and Stability*; 1993.

22. Lohr, K. N., Aaronson, N. K., Alonso, J., Burnam, M. A., Patrick, D. L., Perrin, E. B., Roberts, J. S. Evaluating quality-of-life and health status instruments: development of scientific review criteria. *Clin Ther*; Sep-Oct 1996.

23. Ohlsson, K., Hansson, G. A., Balogh, I., Stromberg, U., Palsson, B., Nordander, C., Rylander, L., Skerfving, S. Disorders of the neck and upper limbs in women in the fish processing industry. *Occup Environ Med*; Dec 1994.

24. Michener, L. A., McClure, P. W., Sennett, B. J. American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form, patient self-report section: reliability, validity, and responsiveness. *J Shoulder Elbow Surg*; Nov-Dec 2002.

25. Roach, K. E., Budiman-Mak, E., Songsiridej, N., Lertratanakul, Y. Development of a shoulder pain and disability index. *Arthritis Care Res*; Dec 1991.

26. Roddey, T. S., Olson, S. L., Cook, K. F., Gartsman, G. M., Hanten, W. Comparison of the University of California-Los Angeles Shoulder Scale and the Simple Shoulder Test with the shoulder pain and disability index: single-administration reliability and validity. *Phys Ther*; Aug 2000.

27. Leggin, B. G., Michener, L. A., Shaffer, M. A., Brenneman, S. K., Iannotti, J. P., Williams, G. R.,Jr. The Penn shoulder score: reliability and validity. *J Orthop Sports Phys Ther*; Mar 2006.

28. Gabel, C. P., Michener, L. A., Burkett, B., Neller, A. The Upper Limb Functional Index: development and determination of reliability, validity, and responsiveness. *J Hand Ther*; Jul-Sep 2006.

29. Gabel, C. P., Yelland, M., Melloh, M., Burkett, B. A modified QuickDASH-9 provides a valid outcome instrument for upper limb function. *BMC Musculoskelet Disord*; 2009.

30. Dawson, J., Fitzpatrick, R., Carr, A. The assessment of shoulder instability. The development and validation of a questionnaire. *J Bone Joint Surg Br*; May 1999.

31. Richardson, A. B. Thoracic outlet syndrome in aquatic athletes. *Clin Sports Med*; Apr 1999.

32. Lynch, NT,Clay,RL,Hegmann,KT,et al. Advocagenic Illness: Proposed Term, Case Reports, and Estimates of Prevalence. *JOEM*; 1998.

33. Tennent, T. D., Beach, W. R., Meyers, J. F. A review of the special tests associated with shoulder examination. Part II: laxity, instability, and superior labral anterior and posterior (SLAP) lesions. *Am J Sports Med*; Mar-Apr 2003.

34. Mirkovic, Milena, Green, Rod, Taylor, Nicholas, Perrott, Margrett. Accuracy of clinical tests to diagnose superior labral anterior and posterior (SLAP) lesions. *Physical Therapy Reviews*; 2005.

35. Walton, D. M., Sadi, J. Identifying SLAP lesions: a meta-analysis of clinical tests and exercise in clinical reasoning. *Phys Ther Sport*; Nov 2008.

36. Wilk, K. E., Reinold, M. M., Dugas, J. R., Arrigo, C. A., Moser, M. W., Andrews, J. R. Current concepts in the recognition and treatment of superior labral (SLAP) lesions. *J Orthop Sports Phys Ther*; May 2005.

37. Berg, E. E., Ciullo, J. V. A clinical test for superior glenoid labral or 'SLAP' lesions. *Clinical Journal Of Sport Medicine: Official Journal Of The Canadian Academy Of Sport Medicine*; Apr 1998.

38. Holtby, R., Razmjou, H. Accuracy of the Speed's and Yergason's tests in detecting biceps pathology and SLAP lesions: comparison with arthroscopic findings. *Arthroscopy*; Mar 2004.

39. Ben Kibler, W., Sciascia, A. D., Hester, P., Dome, D., Jacobs, C. Clinical utility of traditional and new tests in the diagnosis of biceps tendon injuries and superior labrum anterior and posterior lesions in the shoulder. *Am J Sports Med*; Sep 2009.

40. Myers, TH, Zemanovic, JR, Andrews, JR. The resisted supination external rotation test: a new test for the diagnosis of superior labral anterior posterior lesions. *American Journal of Sports Medicine*; Sep 2005.

41. Mimori, K., Muneta, T., Nakagawa, T., Shinomiya, K. A new pain provocation test for superior labral tears of the shoulder. *Am J Sports Med*; Mar-Apr 1999.

42. Ebinger, N., Magosch, P., Lichtenberg, S., Habermeyer, P. A new SLAP test: the supine flexion resistance test. *Arthroscopy: The Journal Of Arthroscopic & Related Surgery: Official Publication Of The Arthroscopy Association Of North America And The International Arthroscopy Association*; May 2008.

43. Stetson, W. B., Templin, K. The crank test, the O'Brien test, and routine magnetic resonance imaging scans in the diagnosis of labral tears. *Am J Sports Med*; Nov-Dec 2002.

44. Liu, SH, Henry, MH, Nuccion, SL. A prospective evaluation of a new physical examination in predicting glenoid labral tears. *American Journal of Sports Medicine*; Nov-Dec 1996.

45. Swaringen, J. C., Mell, A. G., Langenderfer, J., LaScalza, S., Hughes, R. E., Kuhn, J. E. Electromyographic analysis of physical examination tests for type II superior labrum anterior-posterior lesions. *Journal Of Shoulder And Elbow Surgery / American Shoulder And Elbow Surgeons [Et Al]*; Sep-Oct 2006.

46. Green, R. A., Taylor, N. F., Mirkovic, M., Perrott, M. An evaluation of the anatomic basis of the O'Brien active compression test for superior labral anterior and posterior (SLAP) lesions. *J Shoulder Elbow Surg*; Jan-Feb 2008.

47. Jones, G. L., Galluch, D. B. Clinical assessment of superior glenoid labral lesions: a systematic review. *Clin Orthop Relat Res*; Feb 2007.

48. Dessaur, W. A., Magarey, M. E. Diagnostic accuracy of clinical tests for superior labral anterior posterior lesions: a systematic review. *J Orthop Sports Phys Ther*; Jun 2008.

49. Calvert, E.,et al. Special physical examination tests for superior labrum anterior posterior shoulder tears are clinically limited and invalid: a diagnostic systematic review. *J Clin Epidemiol*; 2009.

50. Oh, Joo Han, Kim, Jae Yoon, Kim, Woo Sung, Gong, Hyun Sik, Lee, Ji Ho. The evaluation of various physical examinations for the diagnosis of Type II superior labrum anterior and posterior lesion. *Am J Sports Med*; 2008.

51. Rhee, Y. G., Cho, N. S., Cho, S. H. Traumatic anterior dislocation of the shoulder: factors affecting the progress of the traumatic anterior dislocation. *Clin Orthop Surg*; Dec 2009.

52. McCaughey, R., Green, R. A., Taylor, N. F. The anatomical basis of the resisted supination external rotation test for superior labral anterior to posterior lesions. *Clinical Anatomy (New York, N Y)*; Sep 2009.

53. Kim, J. M., Lee, S. H., Ahn, Y., Yoon, D. H., Lee, C. D., Lim, S. T. Recurrence after successful percutaneous endoscopic lumbar discectomy. *Minim Invasive Neurosurg*; Apr 2007.

54. Hegedus, E.,et al. Physical examination tests of the shoulder: a systematic review with meta-analysis of individual tests. *Br J Sports Med*; 2008.

55. Jain, N. B., Luz, J., Higgins, L. D., Dong, Y., Warner, J. J., Matzkin, E., Katz, J. N. The Diagnostic Accuracy of Special Tests for Rotator Cuff Tear: The ROW Cohort Study. *Am J Phys Med Rehabil*; Mar 2017.

56. Kibler, W. B. Specificity and sensitivity of the anterior slide test in throwing athletes with superior glenoid labral tears. *Arthroscopy*; Jun 1995.

57. Pandya, N. K., Colton, A., Webner, D., Sennett, B., Huffman, G. R. Physical examination and magnetic resonance imaging in the diagnosis of superior labrum anterior-posterior lesions of the shoulder: a sensitivity analysis. *Arthroscopy*; Mar 2008.

58. Dinnes, J., Loveman, E., McIntyre, L., Waugh, N. The effectiveness of diagnostic tests for the assessment of shoulder pain due to soft tissue disorders: a systematic review. *Health Technol Assess*; 2003.

59. Thomas, E., Croft, P. R., Paterson, S. M., Dziedzic, K., Hay, E. M. What influence participants' treatment preference and can it influence outcome? Results from a primary care-based randomised trial for shoulder pain. *British Journal of General Practice*; 2004.

60. Main, C. J., Williams, A. C. Musculoskeletal pain. *BMJ*; Sep 7 2002.

61. Garg, A.,et al. The effect of maximum voluntary contraction on endurance times for the shoulder girdle. *Int J Ind Ergonomics*; 2002.

62. Garg, A.,K. Hegmann,and J. Kapellusch. Maximum one-handed shoulder strength for overhead work as a function of shoulder posture in females. *Occup Ergonomics*; 2005.

63. Garg, A.,K. Hegmann,and J. Kapellusch. Short-cycle overhead work and shoulder girdle muscle fatigue. *Intl J Industrial Ergonomics*; 2006.

64. De Bruijn, C.,et al. Evaluation of an education and activation programme to prevent chronic shoulder complaints: design of an RCT. *BMC Fam Pract*; 2005.

65. Pesco, M.S., E., Chosa, N., Tajima. Comparative study of hands-on therapy with active exercises vs education with active exercises for the management of upper back pain. *J Manipulative Physiol Ther*; 2006.

66. De Bruijn, C., Goossens, M., de Bie, R., Ament, A., Geraets, J., Dinant, G. J. Cost-effectiveness of an education and activation program for patients with acute and subacute shoulder complaints compared to usual care. *Int J Technol Assess Health Care*; Winter 2007.

67. Dziedzic, K.,et al. Development and implementation of a physiotherapy intervention for use in a pragmatic randomized controlled trial in primary care for shoulder pain. *Musculoskeletal Care*; 2009.

68. Mongini, F.,et al. Long-term benefits of an educational and physical program on headache, and neck and shoulder pain, in a working community. *J Pain*; 2009.

69. Lin, S.,et al. Educational program for myofascial pain syndrome. *Journal of Alternative & Complementary Medicine*; 2010.

70. von der Heyde, R.L. Occupational therapy interventions for shoulder conditions: a systematic review. *Am J Occup Ther*; 2011.

71. Manning, V.L.,et al. Education, self-management, and upper extremity exercise training in people with rheumatoid arthritis: a randomized controlled trial. *Arthritis Care Res (Hoboken)*; 2014.

72. Shuai, J.,et al. Assessing the effects of an educational program for the prevention of work-related musculoskeletal disorders among school teachers. *BMC Public Health*; 2014.

73. Chang, K.V.,et al. Early Versus Delayed Passive Range of Motion Exercise for Arthroscopic Rotator Cuff Repair: A Meta-analysis of Randomized Controlled Trials. *Am J Sports Med*; 2015.

74. Dragesund, T. and A. Kvale. Study protocol for Norwegian Psychomotor Physiotherapy versus Cognitive Patient Education in combination with active individualized physiotherapy in patients with long-lasting musculoskeletal pain - a randomized controlled trial. *BMC Musculoskelet Disord*; 2016.

75. Karkucak, M.,et al. Education and Visual Information Improves Effectiveness of Ultrasound-Guided Local Injections on Shoulder Pain and Associated Anxiety Level: A Randomized Controlled Study. *American Journal of Physical Medicine & Rehabilitation*; 2016.

76. George, S. Z., Dover, G. C., Wallace, M. R., Sack, B. K., Herbstman, D. M., Aydog, E., Fillingim, R. B. Biopsychosocial influence on exercise-induced delayed onset muscle soreness at the shoulder: pain catastrophizing and catechol-o-methyltransferase (COMT) diplotype predict pain ratings. *Clin J Pain*; Nov-Dec 2008.

77. van Eck, C.F.,et al. Web-Based Education Prior to Outpatient Orthopaedic Surgery Enhances Early Patient Satisfaction Scores: A Prospective Randomized Controlled Study. *Orthopaedic Journal of Sports Medicine*; 2018.

78. Li, Y. and M.Y.M. Tse. An Online Pain Education Program for Working Adults: Pilot Randomized Controlled Trial. *Journal of Medical Internet Research*; 2020.

79. Turner, J. A., Franklin, G., Fulton-Kehoe, D., Sheppard, L., Wickizer, T. M., Wu, R., Gluck, J. V., Egan, K., Stover, B. Early predictors of chronic work disability associated with carpal tunnel syndrome: a longitudinal workers' compensation cohort study. *Am J Ind Med*; Jul 2007.

80. Bonzani, P. J., Millender, L., Keelan, B., Mangieri, M. G. Factors prolonging disability in work-related cumulative trauma disorders. *J Hand Surg Am*; Jan 1997.

81. Gimeno, D., Amick, B. C.,3rd, Habeck, R. V., Ossmann, J., Katz, J. N. The role of job strain on return to work after carpal tunnel surgery. *Occup Environ Med*; Nov 2005.

82. Faber, E., Kuiper, J. I., Burdorf, A., Miedema, H. S., Verhaar, J. A. Treatment of impingement syndrome: a systematic review of the effects on functional limitations and return to work. *J Occup Rehabil*; Mar 2006.

83. Cheng, A. S., Hung, L. K. Randomized controlled trial of workplace-based rehabilitation for work-related rotator cuff disorder. *J Occup Rehabil*; Sep 2007.

84. Lomond, K. V., Côté, J. N. Shoulder functional assessments in persons with chronic neck/shoulder pain and healthy subjects: Reliability and effects of movement repetition. *Work*; 2011.

85. Moshe, S., Izhaki, R., Chodick, G., Segal, N., Yagev, Y., Finestone, A. S., Juven, Y. Predictors of return to work with upper limb disorders. *Occup Med (Lond)*; Oct 2015.

86. Armijo-Olivo, S., Woodhouse, L. J., Steenstra, I. A., Gross, D. P. Predictive value of the DASH tool for predicting return to work of injured workers with musculoskeletal disorders of the upper extremity. *Occup Environ Med*; Dec 2016.

87. Desmeules, F., Braën, C., Lamontagne, M., Dionne, C. E., Roy, J. S. Determinants and predictors of absenteeism and return-to-work in workers with shoulder disorders. *Work*; Sep 27 2016.

88. Garcia, G. H., Taylor, S. A., Mahony, G. T., DePalma, B. J., Grawe, B. M., Nguyen, J., Dines, J. S., Dines, D. M., Warren, R. F., Craig, E. V., Gulotta, L. V. Reverse total shoulder arthroplasty and work-related outcomes. *Orthopedics*; Mar-Apr 2016.

89. Moll, L. T., Jensen, O. K., Schiøttz-Christensen, B., Stapelfeldt, C. M., Christiansen, D. H., Nielsen, C. V., Labriola, M. Return to work in employees on sick leave due to neck or shoulder pain: a randomized clinical trial comparing multidisciplinary and brief intervention with one-year register-based follow-up. *J Occup Rehabil*; Jun 2018.

90. Minns Lowe, C.,et al. Clinical effectiveness of non-surgical interventions for primary frozen shoulder: A systematic review. *Journal of Rehabilitation Medicine*; 2019.

91. Talmage, JB,Melhorn,JM,Hyman,MH. AMA Guides to the Evaluation of Work Ability and Return to Work. *Chicago, IL: American Medical Association*; 2011.

92. Arnetz, BB,Sjogren,B,Rydehn,B,Meisel,R. Early workplace intervention for employees with musculoskeletal-related absenteeism: a prospective controlled intervention study. *J Occup Environ Med*; 2003.

93. Kuijpers, T., van der Windt, D. A., van der Heijden, G. J., Twisk, J. W., Vergouwe, Y., Bouter, L. M. A prediction rule for shoulder pain related sick leave: a prospective cohort study. *BMC Musculoskelet Disord*; 2006.

94. Descatha, A., Roquelaure, Y., Chastang, J. F., Evanoff, B., Cyr, D., Leclerc, A. Description of outcomes of upper-extremity musculoskeletal disorders in workers highly exposed to repetitive work. *J Hand Surg Am*; May-Jun 2009.

95. Lotters, F., Burdorf, A. Prognostic factors for duration of sickness absence due to musculoskeletal disorders. *Clin J Pain*; Feb 2006.

96. Doxey, Robert, Thiese, Matt S, Hegmann, Kurt T. Reliability of common provocative tests for shoulder tendinitis. *Journal of occupational and environmental medicine*; 2018.

97. Hegmann, Kurt T, Thiese, Matthew S, Wood, Eric M, Garg, Arun, Kapellusch, Jay M, Foster, James, Biggs, Jeremy, Edwards, Hannah, Wertsch, Jacqueline, Kendall, Richard. Impacts of differences in epidemiological case definitions on prevalence for upper-extremity musculoskeletal disorders. *Human factors*; 2014.

98. Sgroi, Mirco, Loitsch, Thomas, Reichel, Heiko, Kappe, Thomas. Diagnostic value of clinical tests for supraspinatus tendon tears. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2018.

99. Hegedus, E. J., Goode, A. P., Cook, C. E., Michener, L., Myer, C. A., Myer, D. M., Wright, A. A. Which physical examination tests provide clinicians with the most value when examining the shoulder? Update of a systematic review with meta-analysis of individual tests. *Br J Sports Med*; Nov 2012.

100. Network-Shoulder, Multicenter,Orthopaedic,Outcomes. Interobserver agreement in the classification of rotator cuff tears. *The American journal of sports medicine*; 2007.

101. Edwards, Anne, Chepeha, Judy, Jones, Allyson, Sheps, David M, Beaupré, Lauren. Can clinical assessment differentiate partial thickness rotator cuff tears from full thickness rotator cuff tears? A secondary analysis. *Disability and rehabilitation*; 2020.

102. Bokor, D. J., Hawkins, R. J., Huckell, G. H., Angelo, R. L., Schickendantz, M. S. Results of nonoperative management of full-thickness tears of the rotator cuff. *Clin Orthop Relat Res*; Sep 1993.

103. Itoi, E., Tabata, S. Conservative treatment of rotator cuff tears. *Clin Orthop Relat Res*; Feb 1992.

104. Goldberg, B. A., Nowinski, R. J., Matsen, F. A.,3rd. Outcome of nonoperative management of full-thickness rotator cuff tears. *Clin Orthop Relat Res*; Jan 2001.

105. Seo, H. G., Bang, M. S., Chung, S. G., Jung, S. H., Lee, S. U. Effect of electrical stimulation on botulinum toxin a therapy in patients with chronic myofascial pain syndrome: a 16-week randomized double-blinded study. *Arch Phys Med Rehabil*; Mar 2013.

106. Shanthanna, H., Busse, J. W., Thabane, L., Paul, J., Couban, R., Choudhary, H., Kaushal, A., Suzumura, E., Kim, I., Harsha, P. Local anesthetic injections with or without steroid for chronic non-cancer pain: A protocol for a systematic review and meta-analysis of randomized controlled trials. *Systematic Reviews*; 2016.

107. Gotoh, Masafumi, Hamada, Kazutoshi, Yamakawa, Hideyuki, Tomonaga, Akihito, Inoue, Akio, Fukuda, Hiroaki. Significance of granulation tissue in torn supraspinatus insertions: An immunohistochemical study with antibodies against interleukin-1β, cathepsin D, and matrix metalloprotease-1. *Journal of orthopaedic research*; 1997.

108. Matthews, T. J., Hand, G. C., Rees, J. L., Athanasou, N. A., Carr, A. J. Pathology of the torn rotator cuff tendon. Reduction in potential for repair as tear size increases. *J Bone Joint Surg Br*; Apr 2006.

109. Sakai, H., Fujita, K., Sakai, Y., Mizuno, K. Immunolocalization of cytokines and growth factors in subacromial bursa of rotator cuff tear patients. *Kobe J Med Sci*; Feb 2001.

110. Gotoh, M., Hamada, K., Yamakawa, H., Inoue, A., Fukuda, H. Increased substance P in subacromial bursa and shoulder pain in rotator cuff diseases. *J Orthop Res*; Sep 1998.

111. Gotoh, M., Hamada, K., Yamakawa, H., Yanagisawa, K., Nakamura, M., Yamazaki, H., Ueyama, Y., Tamaoki, N., Inoue, A., Fukuda, H. Interleukin-1-induced subacromial synovitis and shoulder pain in rotator cuff diseases. *Rheumatology (Oxford)*; Sep 2001.

112. Voloshin, I., Gelinas, J., Maloney, M. D., O'Keefe, R. J., Bigliani, L. U., Blaine, T. A. Proinflammatory cytokines and metalloproteases are expressed in the subacromial bursa in patients with rotator cuff disease. *Arthroscopy*; Sep 2005.

113. Santavirta, S., Konttinen, Y. T., Antti-Poika, I., Nordstrom, D. Inflammation of the subacromial bursa in chronic shoulder pain. *Arch Orthop Trauma Surg*; 1992.

114. Hyvonen, P., Melkko, J., Lehto, V. P., Jalovaara, P. Involvement of the subacromial bursa in impingement syndrome of the shoulder as judged by expression of tenascin-C and histopathology. *J Bone Joint Surg Br*; Mar 2003.

115. Yanagisawa, K., Hamada, K., Gotoh, M., TokunagaT, Oshika, Y., Tomisawa, M., Lee, Y. H., Handa, A., Kijima, H., Yamazaki, H., Nakamura, M., Ueyama, Y., Tamaoki, N., Fukuda, H. Vascular endothelial growth factor (VEGF) expression in the subacromial bursa is increased in patients with impingement syndrome. *J Orthop Res*; May 2001.

116. Bedi, A., Maak, T., Walsh, C., Rodeo, S. A., Grande, D., Dines, D. M., Dines, J. S. Cytokines in rotator cuff degeneration and repair. *J Shoulder Elbow Surg*; Feb 2012.

117. Gotoh, M., Hamada, K., Yamakawa, H., Yanagisawa, K., Nakamura, M., Yamazaki, H., Inoue, A., Fukuda, H. Interleukin-1-induced glenohumeral synovitis and shoulder pain in rotator cuff diseases. *J Orthop Res*; Nov 2002.

118. Lho, Y. M., Ha, E., Cho, C. H., Song, K. S., Min, B. W., Bae, K. C., Lee, K. J., Hwang, I., Park, H. B. Inflammatory cytokines are overexpressed in the subacromial bursa of frozen shoulder. *J Shoulder Elbow Surg*; May 2013.

119. Longo, U. G., Rizzello, G., Berton, A., Maltese, L., Fumo, C., Khan, W. S., Denaro, V. Biological strategies to enhance rotator cuff healing. *Curr Stem Cell Res Ther*; Nov 2013.

120. Millar, N. L., Reilly, J. H., Kerr, S. C., Campbell, A. L., Little, K. J., Leach, W. J., Rooney, B. P., Murrell, G. A., McInnes, I. B. Hypoxia: a critical regulator of early human tendinopathy. *Ann Rheum Dis*; Feb 2012.

121. Millar, N. L., Wei, A. Q., Molloy, T. J., Bonar, F., Murrell, G. A. Cytokines and apoptosis in supraspinatus tendinopathy. *J Bone Joint Surg Br*; Mar 2009.

122. Pedersen, B. K., Steensberg, A., Schjerling, P. Muscle-derived interleukin-6: possible biological effects. *J Physiol*; Oct 15 2001.

123. Rosendal, L., Kristiansen, J., Gerdle, B., Sogaard, K., Peolsson, M., Kjaer, M., Sorensen, J., Larsson, B. Increased levels of interstitial potassium but normal levels of muscle IL-6 and LDH in patients with trapezius myalgia. *Pain*; Dec 15 2005.

124. Wu, G., Xu, P. C., Wu, P., Hu, K., Sun, Y., Cheng, B., Lu, Y. Advances in the treatment of rotator cuff lesions by cytokines. *Front Biosci (Landmark Ed)*; Jan 1 2017.

125. Yamazaki, H., Ochiai, N., Kenmoku, T., Ohtori, S., Sasho, T., Miyagi, M., Ishikawa, T., Kamoda, H., Orita, S., Sasaki, Y., Yamaguchi, T., Kijima, T., Takahashi, K. Assessment of pain-related behavior and pro-inflammatory cytokine levels in the rat rotator cuff tear model. *J Orthop Res*; Feb 2014.

126. Bonsell, S., Pearsall, A. W. th, Heitman, R. J., Helms, C. A., Major, N. M., Speer, K. P. The relationship of age, gender, and degenerative changes observed on radiographs of the shoulder in asymptomatic individuals. *J Bone Joint Surg Br*; Nov 2000.

127. Hardy, D. C., Vogler, J. B.,3rd, White, R. H. The shoulder impingement syndrome: prevalence of radiographic findings and correlation with response to therapy. *AJR Am J Roentgenol*; Sep 1986.

128. Barile, A., Bruno, F., Mariani, S., Arrigoni, F., Reginelli, A., De Filippo, M., Zappia, M., Splendiani, A., Di Cesare, E., Masciocchi, C. What can be seen after rotator cuff repair: a brief review of diagnostic imaging findings. *Musculoskelet Surg*; Mar 2017.

129. Burbank, K. M., Stevenson, J. H., Czarnecki, G. R., Dorfman, J. Chronic shoulder pain: part I. Evaluation and diagnosis. *Am Fam Physician*; Feb 15 2008.

130. Cadogan, A., McNair, P. J., Laslett, M., Hing, W. A. Diagnostic Accuracy of Clinical Examination and Imaging Findings for Identifying Subacromial Pain. *PLoS One*; 2016.

131. Guckel, C., Nidecker, A. Diagnosis of tears in rotator-cuff-injuries. *Eur J Radiol*; Nov 1997.

132. Hussain, Adnan, Muzzammil, Muhammad, Butt, Faisal, Valsamis, Epaminondas Markos, Dwyer, Amitabh J. Effectiveness of plain shoulder radiograph in detecting degenerate rotator cuff tears. *Journal of Ayub Medical College Abbottabad*; 2018.

133. Kim, J. H., Gwak, H. C., Kim, C. W., Lee, C. R., Kwon, Y. U., Seo, H. W. Difference of Critical Shoulder Angle (CSA) According to Minimal Rotation: Can Minimal Rotation of the Scapula Be Allowed in the Evaluation of CSA? *Clin Orthop Surg*; Sep 2019.

134. Loew, M., Magosch, P., Lichtenberg, S., Habermeyer, P., Porschke, F. How to discriminate between acute traumatic and chronic degenerative rotator cuff lesions: an analysis of specific criteria on radiography and magnetic resonance imaging. *J Shoulder Elbow Surg*; Nov 2015.

135. Song, J. G., Yun, S. J., Song, Y. W., Lee, S. H. High performance of critical shoulder angle for diagnosing rotator cuff tears on radiographs. *Knee Surg Sports Traumatol Arthrosc*; Jan 2019.

136. Zhang, C., Skalli, W., Lagace, P. Y., Billuart, F., Ohl, X., Cresson, T., Bureau, N. J., Rouleau, D. M., Roy, A., Tetreault, P., Sauret, C., de Guise, J. A., Hagemeister, N. Investigation of 3D glenohumeral displacements from 3D reconstruction using biplane X-ray images: Accuracy and reproducibility of the technique and preliminary analysis in rotator cuff tear patients. *J Electromyogr Kinesiol*; Aug 2016.

137. Bryant, L., Shnier, R., Bryant, C., Murrell, G. A. A comparison of clinical estimation, ultrasonography, magnetic resonance imaging, and arthroscopy in determining the size of rotator cuff tears. *J Shoulder Elbow Surg*; May-Jun 2002.

138. Singisetti, Kiran, Hinsche, Andreas. Shoulder ultrasonography versus arthroscopy for the detection of rotator cuff tears: analysis of errors. *Journal of Orthopaedic Surgery*; 2011.

139. Teefey, S. A., Hasan, S. A., Middleton, W. D., Patel, M., Wright, R. W., Yamaguchi, K. Ultrasonography of the rotator cuff. A comparison of ultrasonographic and arthroscopic findings in one hundred consecutive cases. *J Bone Joint Surg Am*; Apr 2000.

140. Ward, Jonathan RN, Lotfi, Naeil, Dias, Richard G, McBride, Timothy J. Diagnostic difficulties in the radiological assessment of subscapularis tears. *Journal of orthopaedics*; 2018.

141. Fouse, M., Nottage, W. M. All-arthroscopic rotator cuff repair. *Sports Med Arthrosc*; Dec 2007.

142. Abrams, J.S. Arthroscopic approach to massive rotator cuff tears. *Instr Course Lect*; 2006.

143. Baker, C. L., Whaley, A. L., Baker, M. Arthroscopic rotator cuff tear repair. *J Surg Orthop Adv*; Winter 2003.

144. Ahmad, C. S., Levine, W. N., Bigliani, L. U. Arthroscopic rotator cuff repair. *Orthopedics*; Jun 2004.

145. Boszotta, H., Prunner, K. Arthroscopically assisted rotator cuff repair. *Arthroscopy*; Jul 2004.

146. van de Sande, Michiel AJ, Stoel, Berend C, Obermann, Wim R, a Lieng, John GS Tjong, Rozing, Piet M. Quantitative assessment of fatty degeneration in rotator cuff muscles determined with computed tomography. *Investigative radiology*; 2005.

147. Moghekar, A. R., Karli, N., Chaudhry, V. Brachial plexopathies: etiology, frequency, and electrodiagnostic localization. *J Clin Neuromuscul Dis*; Sep 2007.

148. Wilbourn, A. J. Plexopathies. *Neurol Clin*; Feb 2007.

149. Mayer, T. G., Gatchel, R. J., Mayer, H., Kishino, N. D., Keeley, J., Mooney, V. A prospective two-year study of functional restoration in industrial low back injury. An objective assessment procedure. *Jama*; Oct 2 1987.

150. Abdel-Moty, E., Fishbain, D. A., Khalil, T. M., Sadek, S., Cutler, R., Rosomoff, R. S., Rosomoff, H. L. Functional capacity and residual functional capacity and their utility in measuring work capacity. *Clin J Pain*; Sep 1993.

151. Chan, G., Tan, V., Koh, D. Ageing and fitness to work. *Occup Med (Lond)*; Sep 2000.

152. Gouttebarge, V., Wind, H., Kuijer, P. P., Frings-Dresen, M. H. Reliability and validity of Functional Capacity Evaluation methods: a systematic review with reference to Blankenship system, Ergos work simulator, Ergo-Kit and Isernhagen work system. *Int Arch Occup Environ Health*; Nov 2004.

153. Gross, D. P., Battie, M. C. Functional capacity evaluation performance does not predict sustained return to work in claimants with chronic back pain. *J Occup Rehabil*; Sep 2005.

154. Gross, DP, Battie, MC, A, Asante. Development and validation of a short-form functional capacity evaluation for use in claimants with low back disorders. *J Occup Rehabil*; 2006.

155. Ilmarinen, J., Tuomi, K., Eskelinen, L., Nygard, C. H., Huuhtanen, P., Klockars, M. Background and objectives of the Finnish research project on aging workers in municipal occupations. *Scand J Work Environ Health*; 1991.

156. Jones, T., Kumar, S. Functional capacity evaluation of manual materials handlers: a review. *Disabil Rehabil*; Feb 18-Mar 4 2003.

157. Kaplan, G. M., Wurtele, S. K., Gillis, D. Maximal effort during functional capacity evaluations: an examination of psychological factors. *Arch Phys Med Rehabil*; Feb 1996.

158. King, P. M., Tuckwell, N., Barrett, T. E. A critical review of functional capacity evaluations. *Phys Ther*; Aug 1998.

159. Kuijer, P. P., Gouttebarge, V., Brouwer, S., Reneman, M. F., Frings-Dresen, M. H. Are performance-based measures predictive of work participation in patients with musculoskeletal disorders? A systematic review. *Int Arch Occup Environ Health*; Feb 2012.

160. Mahmud, N., Schonstein, E., Schaafsma, F., Lehtola, M. M., Fassier, J. B., Verbeek, J. H., Reneman, M. F. Functional capacity evaluations for the prevention of occupational re-injuries in injured workers. *Cochrane Database Syst Rev*; 2010.

161. Marfeo, E. E., Haley, S. M., Jette, A. M., Eisen, S. V., Ni, P., Bogusz, K., Meterko, M., McDonough, C. M., Chan, L., Brandt, D. E., Rasch, E. K. Conceptual foundation for measures of physical function and behavioral health function for Social Security work disability evaluation. *Arch Phys Med Rehabil*; Sep 2013.

162. McFadden, S., MacDonald, A., Fogarty, A., Le, S., Merritt, B. K. Vocational assessment: a review of the literature from an occupation-based perspective. *Scand J Occup Ther*; 2010.

163. Oesch, P., Meyer, K., Bachmann, S., Hagen, K. B., Vollestad, N. K. Comparison of two methods for interpreting lifting performance during functional capacity evaluation. *Phys Ther*; Sep 2012.

164. Reneman, M. F., Kool, J., Oesch, P., Geertzen, J. H., Battie, M. C., Gross, D. P. Material handling performance of patients with chronic low back pain during functional capacity evaluation: a comparison between three countries. *Disabil Rehabil*; Sep 30 2006.

165. Spanjer, J., Groothoff, J. W., Brouwer, S. Instruments used to assess functional limitations in workers applying for disability benefit: a systematic review. *Disabil Rehabil;* 2011.

166. Tramposh, A. K. The functional capacity evaluation: measuring maximal work abilities. *Occup Med*; Jan-Mar 1992.

167. Tuomi, K., Ilmarinen, J., Martikainen, R., Aalto, L., Klockars, M. Aging, work, life-style and work ability among Finnish municipal workers in 1981-1992. *Scand J Work Environ Health*; 1997.

168. van Abbema, R., Lakke, S. E., Reneman, M. F., van der Schans, C. P., van Haastert, C. J., Geertzen, J. H., Wittink, H. Factors associated with functional capacity test results in patients with non-specific chronic low back pain: a systematic review. *J Occup Rehabil*; Dec 2011.

169. Wind, H., Gouttebarge, V., Kuijer, P. P., Sluiter, J. K., Frings-Dresen, M. H. Effect of Functional Capacity Evaluation information on the judgment of physicians about physical work ability in the context of disability claims. *Int Arch Occup Environ Health*; Oct 2009.

170. Gibson, L., Strong, J. Safety issues in functional capacity evaluation: findings from a trial of a new approach for evaluating clients with chronic back pain. *J Occup Rehabil*; Jun 2005.

171. Gibson, L., Strong, J., Wallace, A. Functional capacity evaluation as a performance measure: evidence for a new approach for clients with chronic back pain. *Clin J Pain*; May-Jun 2005.

172. Spanjer, J., Krol, B., Brouwer, S., Popping, R., Groothoff, J. W., van der Klink, J. J. Reliability and validity of the Disability Assessment Structured Interview (DASI): a tool for assessing functional limitations in claimants. *J Occup Rehabil*; Mar 2010.

173. Hunter, J. C., Blatz, D. J., Escobedo, E. M. SLAP lesions of the glenoid labrum: CT arthrographic and arthroscopic correlation. *Radiology*; Aug 1992.

174. Palmer, W. E. MR arthrography of the rotator cuff and labral-ligamentous complex. *Semin Ultrasound CT MR*; Aug 1997.

175. Peh, W. C. Magnetic resonance arthrography of the labral-ligamentous complex of the shoulder: an update. *Ann Acad Med Singapore*; Sep 2002.

176. Waldt, S., Burkart, A., Lange, P., Imhoff, A. B., Rummeny, E. J., Woertler, K. Diagnostic performance of MR arthrography in the assessment of superior labral anteroposterior lesions of the shoulder. *AJR American Journal Of Roentgenology*; May 2004.

177. Jee, W. H., McCauley, T. R., Katz, L. D., Matheny, J. M., Ruwe, P. A., Daigneault, J. P. Superior labral anterior posterior (SLAP) lesions of the glenoid labrum: reliability and accuracy of MR arthrography for diagnosis. *Radiology*; Jan 2001.

178. Lin, E. Magnetic resonance arthrography of superior labrum anterior-posterior lesions: a practical approach to interpretation. *Curr Prob Diagn Radiol*; 2009.

179. Bencardino, J. T., Beltran, J., Rosenberg, Z. S., Rokito, A., Schmahmann, S., Mota, J., Mellado, J. M., Zuckerman, J., Cuomo, F., Rose, D. Superior labrum anterior-posterior lesions: diagnosis with MR arthrography of the shoulder. *Radiology*; Jan 2000.

180. Monu, J. U., Pope, T. L. MR diagnosis of superior labral anterior posterior (SLAP) injuries of the glenoid labrum: value of routine imaging without intraarticular injection of contrast material. *Am J Roentgenology*; 1994.

181. Beall, D. P., Williamson, E. E., Ly, J. Q., Adkins, M. C., Emery, R. L., Jones, T. P., Rowland, C. M. Association of biceps tendon tears with rotator cuff abnormalities: degree of correlation with tears of the anterior and superior portions of the rotator cuff. *AJR Am J Roentgenol*; Mar 2003.

182. Zubler, Christoph, Mengiardi, Bernard, Schmid, Marius R, Hodler, Juerg, Jost, Bernhard, Pfirrmann, Christian WA. MR arthrography in calcific tendinitis of the shoulder: diagnostic performance and pitfalls. *European radiology*; 2007.

183. Ball, Craig M. Arthroscopic rotator cuff repair: magnetic resonance arthrogram assessment of tendon healing. *Journal of shoulder and elbow surgery*; 2019.

184. Ardic, F., Kahraman, Y., Kacar, M., Kahraman, M. C., Findikoglu, G., Yorgancioglu, Z. R. Shoulder impingement syndrome: relationships between clinical, functional, and radiologic findings. *Am J Phys Med Rehabil*; Jan 2006.

185. Naqvi, G. A., Jadaan, M., Harrington, P. Accuracy of ultrasonography and magnetic resonance imaging for detection of full thickness rotator cuff tears. *Int J Shoulder Surg*; Oct 2009.

186. Ianotti, J. P. Review: relocation and anterior release tests diagnose shoulder instability in selected patients. *J Bone Joint Surg Am*; May 2005.

187. Moosikasuwan, J. B., Miller, T. T., Burke, B. J. Rotator cuff tears: clinical, radiographic, and US findings. *Radiographics*; Nov-Dec 2005.

188. Crass, J. R., Craig, E. V., Feinberg, S. B. Ultrasonography of rotator cuff tears: a review of 500 diagnostic studies. *J Clin Ultrasound*; Jun 1988.

189. Shahabpour, M., Kichouh, M., Laridon, E., Gielen, J. L., De Mey, J. The effectiveness of diagnostic imaging methods for the assessment of soft tissue and articular disorders of the shoulder and elbow. *Eur J Radiol*; Feb 2008.

190. Middleton, William D, Edelstein, Gerald, Reinus, WR, Melson, G Leland, Totty, William G, Murphy, William A. Sonographic detection of rotator cuff tears. *American journal of roentgenology*; 1985.

191. Anderson, Mark W, Brennan, Christopher, Mittal, Amit. Imaging evaluation of the rotator cuff. *Clinics in sports medicine*; 2012.

192. McCreesh, Karen M, Anjum, Shakeel, Crotty, James M, Lewis, Jeremy S. Ultrasound measures of supraspinatus tendon thickness and acromiohumeral distance in rotator cuff tendinopathy are reliable. *Journal of clinical ultrasound*; 2016.

193. Al-faham, Z., Jolepalem, P. Use of SPECT/CT with 99mTc-MDP Bone Scintigraphy to Diagnose Symptomatic Os Acromiale. *J Nucl Med Technol*; Sep 2015.

194. Park, J. Y., Park, S. G., Keum, J. S., Oh, J. H., Park, J. S. The diagnosis and prognosis of impingement syndrome in the shoulder with using quantitative SPECT assessment: a prospective study of 73 patients and 24 volunteers. *Clin Orthop Surg*; Dec 2009.

195. Thelu-Vanysacker, M., Frederic, P., Charles-Edouard, T., Alban, B., Nicolas, B., Tanguy, B. SPECT/CT in Postoperative Shoulder Pain. *Semin Nucl Med*; Sep 2018.

196. Henckaerts, L., Gheysens, O., Vanderschueren, S., Goffin, K., Blockmans, D. Use of 18 f-fluorodeoxyglucose positron emission tomography in the diagnosis of polymyalgia rheumatica — A prospective study of 99 patients. *Rheumatology (United Kingdom)*; 2018.

197. Moon, Y. L., Lee, S. H., Park, S. Y., Yu, J. C., Gorthi, V. Evaluation of shoulder disorders by 2-[F-18]-fluoro-2-deoxy-D-glucose positron emission tomography and computed tomography. *Clinics in orthopedic surgery*; 2010.

198. Shinozaki, N., Sano, H., Omi, R., Kishimoto, K. N., Yamamoto, N., Tashiro, M., Itoi, E. Differences in muscle activities during shoulder elevation in patients with symptomatic and asymptomatic rotator cuff tears: analysis by positron emission tomography. *J Shoulder Elbow Surg*; Mar 2014.

199. Blanchard, T. K., Constant, C. R., Bearcroft, P. W., Marshall, T. J., Dixon, A. K. Imaging of the rotator cuff: an arthrographic pitfall. *Eur Radiol*; 1998.

200. Boudreau, Nicolas, Gaudreault, Nathaly, Roy, Jean-Sébastien, Bédard, Sonia, Balg, Frédéric. The Addition of Glenohumeral Adductor Coactivation to a Rotator Cuff Exercise Program for Rotator Cuff Tendinopathy: A Single-Blind Randomized Controlled Trial. *journal of orthopaedic & sports physical therapy*; 2019.

201. Ager, Amanda L, Roy, Jean-Sébastien, Gamache, France, Hébert, Luc J. The effectiveness of an upper extremity neuromuscular training program on the shoulder function of military members with a rotator cuff tendinopathy: a pilot randomized controlled trial. *Military medicine*; 2019.

202. Bron, C., Wensing, M., Franssen, J. L., Oostendorp, R. A. Treatment of myofascial trigger points in common shoulder disorders by physical therapy: a randomized controlled trial [ISRCTN75722066]. *BMC Musculoskelet Disord*; 2007.

203. Green, S, Buchbinder, R, Hetrick, SE. Physiotherapy interventions for shoulder pain. *Cochrane Database of Systematic Reviews*; 2003.

204. Ingwersen, Kim Gordon, Jensen, Steen Lund, Sørensen, Lilli, Jørgensen, Hans Ri, Christensen, Robin, Søgaard, Karen, Juul-Kristensen, Birgit. Three months of progressive high-load versus traditional low-load strength training among patients with rotator cuff tendinopathy: primary results from the double-blind randomized controlled RoCTEx Trial. *Orthopaedic Journal of Sports Medicine*; 2017.

205. Littlewood, Chris, Malliaras, Peter, Mawson, Sue, May, Stephen, Walters, Stephen J. Self-managed loaded exercise versus usual physiotherapy treatment for rotator cuff tendinopathy: a pilot randomised controlled trial. *Physiotherapy*; 2014.

206. Moosmayer, Stefan, Lund, Gerty, Seljom, Unni S, Haldorsen, Benjamin, Svege, Ida C, Hennig, Toril, Pripp, Are H, Smith, Hans-Jørgen. At a 10-year follow-up, tendon repair is superior to physiotherapy in the treatment of small and medium-sized rotator cuff tears. *JBJS*; 2019.

207. Rhon, Daniel I, Boyles, Robert B, Cleland, Joshua A. One-year outcome of subacromial corticosteroid injection compared with manual physical therapy for the management of the unilateral shoulder impingement syndrome: a pragmatic randomized trial. *Annals of internal medicine*; 2014.

208. Gleyze, P.,et al. Comparison and critical evaluation of rehabilitation and home-based exercises for treating shoulder stiffness: Prospective, multicenter study with 148 cases. *Orthopaedics & Traumatology: Surgery & Research*; 2011.

209. Karagülle, M.,S. Kardeş,and M.Z. Karagülle. Real-life effectiveness of spa therapy in rheumatic and musculoskeletal diseases: a retrospective study of 819 patients. *International journal of biometeorology*; 2017.

210. Koç, Cihan, Kurt, Emine Eda, Koçak, Fatmanur Aybala, Erdem, Hatice Rana, Konar, Naime Meriç. Does balneotherapy provide additive effects to physical therapy in patients with subacute supraspinatus tendinopathy? A randomized, controlled, single-blind study. *International Journal of Biometeorology*; 2021.

211. Özkuk, K. and Z. Ateş. Balneotherapy in the Treatment of Chronic Shoulder Pain: A Randomized Controlled Clinical Trial. *Alternative Therapies in Health & Medicine*; 2020.

212. Pille, V.,et al. Work-related musculoskeletal symptoms in industrial workers and the effect of balneotherapy. 2009.

213. Tefner, Ildikó Katalin, Kovács, Csaba, Gaál, Ramóna, Koroknai, András, Horváth, Remény, Badruddin, Rakib Mohammed, Borbély, Ildikó, Nagy, Katalin, Bender, Tamás. The effect of balneotherapy on chronic shoulder pain. A randomized, controlled, single-blind follow-up trial. A pilot study. *Clinical rheumatology*; 2015.

214. Verhagen, A.P.,et al. Balneotherapy and quality assessment: interobserver reliability of the Maastricht criteria list and the need for blinded quality assessment. *Journal of clinical epidemiology*; 1998.

215. Bervoets, Diederik C, Luijsterburg, Pim AJ, Alessie, Jeroen JN, Buijs, Martijn J, Verhagen, Arianne P. Massage therapy has short-term benefits for people with common musculoskeletal disorders compared to no treatment: a systematic review. *Journal of physiotherapy*; 2015.

216. van den Dolder, P. A., Roberts, D. L. A trial into the effectiveness of soft tissue massage in the treatment of shoulder pain. *Aust J Physiother*; 2003.

217. van den Dolder, P.A.,P.H. Ferreira,and K.M. Effectiveness of Soft Tissue Massage for Nonspecific Shoulder Pain: Randomized Controlled Trial. *Phys Ther*; 2015.

218. Ernst, Edzard. Is reflexology an effective intervention? A systematic review of randomised controlled trials. *Medical Journal of Australia*; 2009.

219. Ernst, Edzard, Köder, Kerstin. An overview of reflexology. *The European Journal of General Practice*; 1997.

220. Soliman, AYMAN S, Mahmoud, AYMAN M, Serry, ZM, Dawood, FADY G. Therapeutic effects of low-level laser and reflexology on adhesive capsulitis in elderly type 2 diabetic patients. *Asian J Pharm Clin Res*; 2014.

221. Nabeta, T., Kawakita, K. Relief of chronic neck and shoulder pain by manual acupuncture to tender points--a sham-controlled randomized trial. *Complement Ther Med*; Dec 2002.

222. de Hoyos, Juan Antonio Guerra, Martín, Maria del Carmen Andrés, Lopez, Miguel Vigára, López, Teresa Molina, Morilla, Francisco Antonio Verdugo, Moreno, Maria José González. Randomised trial of long term effect of acupuncture for shoulder pain. *Pain*; 2004.

223. Kleinhenz, J., Streitberger, K., Windeler, J., Gussbacher, A., Mavridis, G., Martin, E. Randomised clinical trial comparing the effects of acupuncture and a newly designed placebo needle in rotator cuff tendinitis. *Pain*; Nov 1999.

224. Kong, J. C., Lee, M. S., Shin, B. C. Randomized clinical trials on acupuncture in korean literature: a systematic review. *Evid Based Complement Alternat Med*; Mar 2009.

225. Vas, J., Ortega, C., Olmo, V., Perez-Fernandez, F., Hernandez, L., Medina, I., Seminario, J. M., Herrera, A., Luna, F., Perea-Milla, E., Mendez, C., Madrazo, F., Jimenez, C., Ruiz, M. A., Aguilar, I. Single-point acupuncture and physiotherapy for the treatment of painful shoulder: a multicentre randomized controlled trial. *Rheumatology (Oxford)*; Jun 2008.

226. Green, S., Buchbinder, R., Hetrick, S. Acupuncture for shoulder pain. *Cochrane Database Syst Rev*; 2005.

227. Grant, H. J., Arthur, A., Pichora, D. R. Evaluation of interventions for rotator cuff pathology: a systematic review. *J Hand Ther*; Apr-Jun 2004.

228. Baldry, P. Superficial versus deep dry needling. *Acupunct Med*; Aug 2002.

229. Choi, S., Kim, K. H. Acupuncture for symptomatic rotator cuff disease: Protocol for a systematic review and meta-analysis. *Medicine (United States)*; 2020.

230. Koh, P. S., Seo, B. K., Cho, N. S., Park, H. S., Park, D. S., Baek, Y. H. Clinical effectiveness of bee venom acupuncture and physiotherapy in the treatment of adhesive capsulitis: a randomized controlled trial. *J Shoulder Elbow Surg*; Aug 2013.

231. Lee, Sook-Hyun, Lim, Sung Min. Acupuncture for Poststroke Shoulder Pain: A Systematic Review and Meta-Analysis. *Evidence-based Complementary & Alternative Medicine (eCAM)*; 2016.

232. Nielsen, A., Wieland, L. S. Cochrane reviews on acupuncture therapy for pain: A snapshot of the current evidence. *Explore*; 2019.

233. Park, Y., Sung, W., Goo, B., Seo, B., Yeom, S., Baek, Y. The effectiveness and safety of thread-embedding acupuncture for chronic rotator cuff disease: A study protocol for a randomized, patient-assessor-blinded, controlled, clinical trial. *European Journal of Integrative Medicine*; 2019.

234. Yu-Ri, Seo, Woo-Sang, Jung, Seong-Uk, Park, Sang-Kwan, Moon, Jung-Mi, Park, Joo-Young, Park. The Effect of Ouhyul Herbal Acupuncture Point Injections on Shoulder Pain after Stroke. *Evidence-based Complementary & Alternative Medicine (eCAM)*; 2013.

235. Page, Matthew J, Green, Sally, McBain, Brodwen, Surace, Stephen J, Deitch, Jessica, Lyttle, Nicolette, Mrocki, Marshall A, Buchbinder, Rachelle. Manual therapy and exercise for rotator cuff disease. *Cochrane Database of Systematic Reviews*; 2016.

236. Garofalo, R., Conti, M., Notarnicola, A., Maradei, L., Giardella, A., Castagna, A. Effects of one-month continuous passive motion after arthroscopic rotator cuff repair: results at 1-year follow-up of a prospective randomized study. *Musculoskelet Surg*; May 2010.

237. Kuhn, J. E., Dunn, W. R., Sanders, R., An, Q., Baumgarten, K. M., Bishop, J. Y., Brophy, R. H., Carey, J. L., Holloway, B. G., Jones, G. L., Ma, C. B., Marx, R. G., McCarty, E. C., Poddar, S. K., Smith, M. V., Spencer, E. E., Vidal, A. F., Wolf, B. R., Wright, R. W., Group, Moon,Shoulder. Effectiveness of physical therapy in treating atraumatic full-thickness rotator cuff tears: a multicenter prospective cohort study. *J Shoulder Elbow Surg*; Oct 2013.

238. Lee, B. G., Cho, N. S., Rhee, Y. G. Effect of two rehabilitation protocols on range of motion and healing rates after arthroscopic rotator cuff repair: aggressive versus limited early passive exercises. *Arthroscopy*; Jan 2012.

239. Seida, J. C., LeBlanc, C., Schouten, J. R., Mousavi, S. S., Hartling, L., Vandermeer, B., Tjosvold, L., Sheps, D. M. Systematic review: nonoperative and operative treatments for rotator cuff tears. *Ann Intern Med*; Aug 17 2010.

240. Nejati, P.,et al. Treatment of subacromial impingement syndrome: platelet-rich plasma or exercise therapy? A randomized controlled trial. *Orthopaedic journal of sports medicine*; 2017.

241. Li, S,et al. The clinical effect of rehabilitation following arthroscopic rotator cuff repair: A meta-analysis of early versus delayed passive motion. *Medicine*; 2018.

242. Bennell, K.,et al. Efficacy of standardised manual therapy and home exercise programme for chronic rotator cuff disease: randomised placebo controlled trial. *BMJ*; 2010.

243. Thomson, S, Jukes, C, Lewis, J. Rehabilitation following surgical repair of the rotator cuff: a systematic review. *Physiotherapy*; 2016.

244. Grana, W. A. Physical agents in musculoskeletal problems: heat and cold therapy modalities. *Instr Course Lect*; 1993.

245. Michlovitz, SL. Thermal agents in rehabilitation. 1996.

246. Melzack, R., Jeans, M. E., Stratford, J. G., Monks, R. C. Ice massage and transcutaneous electrical stimulation: comparison of treatment for low-back pain. *Pain*; Oct 1980.

247. Nadler, S. F. Nonpharmacologic management of pain. *J Am Osteopath Assoc*; Nov 2004.

248. Hashimoto, Takashi, Nobuhara, Katsuya, Hamada, Tetsuo. Pathologic evidence of degeneration as a primary cause of rotator cuff tear. *Clinical Orthopaedics and Related Research®*; 2003.

249. Hegedus, Eric J, Cook, Chad, Brennan, Matthew, Wyland, Douglas, Garrison, J Craig, Driesner, Dawn. Vascularity and tendon pathology in the rotator cuff: a review of literature and implications for rehabilitation and surgery. *British journal of sports medicine*; 2010.

250. Viikari-Juntura, E., Shiri, R., Solovieva, S., Karppinen, J., Leino-Arjas, P., Varonen, H., Kalso, E., Ukkola, O. Risk factors of atherosclerosis and shoulder pain--is there an association? A systematic review. *Eur J Pain*; May 2008.

251. Morken, T., Moen, B., Riise, T., Bergum, O., Bua, L., Hauge, S. H., Holien, S., Langedrag, A., Olson, H. O., Pedersen, S., Saue, I. L., Seljebo, G. M., Thoppil, V. Prevalence of musculoskeletal symptoms among aluminium workers. *Occup Med (Lond)*; Aug 2000.

252. Silverstein, B. A., Bao, S. S., Fan, Z. J., Howard, N., Smith, C., Spielholz, P., Bonauto, D., Viikari-Juntura, E. Rotator cuff syndrome: personal, work-related psychosocial and physical load factors. *J Occup Environ Med*; Sep 2008.

253. Miranda, H., Viikari-Juntura, E., Martikainen, R., Takala, E. P., Riihimaki, H. A prospective study of work related factors and physical exercise as predictors of shoulder pain. *Occup Environ Med*; Aug 2001.

254. Parle, Phillip J, Riddiford-Harland, Diane L, Howitt, Chris D, Lewis, Jeremy S. Acute rotator cuff tendinopathy: does ice, low load isometric exercise, or a combination of the two produce an analgaesic effect? *British Journal of Sports Medicine*; 2017.

255. Saito, N., Horiuchi, H., Kobayashi, S., Nawata, M., Takaoka, K. Continuous local cooling for pain relief following total hip arthroplasty. *J Arthroplasty*; Apr 2004.

256. Vasudevan, S.V. Physical rehabilitation in managing pain. *Pain: Clinical Updates*; 1997.

257. de Freitas, Diego Galace, Marcondes, Freddy Beretta, Monteiro, Renan Lima, Rosa, Sabrina Gonçalves, Fucs, Patrícia Maria de Moraes Barros, Fukuda, Thiago Yukio. Pulsed electromagnetic field and exercises in patients with shoulder impingement syndrome: a randomized, double-blind, placebo-controlled clinical trial. *Archives of physical medicine and rehabilitation*; 2014.

258. Akyol, Y., Ulus, Y., Durmus, D., Canturk, F., Bilgici, A., Kuru, O., Bek, Y. Effectiveness of microwave diathermy on pain, functional capacity, muscle strength, quality of life, and depression in patients with subacromial impingement syndrome: a randomized placebo-controlled clinical study. *Rheumatol Int*; Oct 2012.

259. Yilmaz Kaysin, M., Akpinar, P., Aktas, I., Unlü Ozkan, F., Silte Karamanlioglu, D., Cagliyan Hartevioglu, H., Vural, N. Effectiveness of Shortwave Diathermy for Subacromial Impingement Syndrome and Value of Night Pain for Patient Selection: A Double-Blinded, Randomized, Placebo-Controlled Trial. *Am J Phys Med Rehabil*; Mar 2018.

260. Page, M.J.,et al. Electrotherapy modalities for rotator cuff disease. *Cochrane Database of Systematic Reviews*; 2016.

261. Kim, G.-W.,et al. Effects of a Newly Developed Therapeutic Deep Heating Device Using High Frequency in Patients with Shoulder Pain and Disability: A Pilot Study. *Pain Research and Management*; 2019.

262. Smith, T. O., Back, T., Toms, A. P., Hing, C. B. Diagnostic accuracy of ultrasound for rotator cuff tears in adults: a systematic review and meta-analysis. *Clin Radiol*; Nov 2011.

263. Robertson, V. J., Baker, K. G. A review of therapeutic ultrasound: effectiveness studies. *Phys Ther*; Jul 2001.

264. Members, Philadelphia,Panel, Experts, Clinical,Specialty, Albright, John, Allman, Richard, Bonfiglio, Richard Paul, Conill, Alicia, Dobkin, Bruce, Guccione, Andrew A, Hasson, Scott, Russo, Randolph. Philadelphia Panel evidence-based clinical practice guidelines on selected rehabilitation interventions for shoulder pain. *Physical Therapy*; 2001.

265. Berry, H., Fernandes, L., Bloom, B., Clark, R. J., Hamilton, E. B. Clinical study comparing acupuncture, physiotherapy, injection and oral anti-inflammatory therapy in shoulder-cuff lesions. *Curr Med Res Opin*; 1980.

266. Downing, D. S., Weinstein, A. Ultrasound therapy of subacromial bursitis. A double blind trial. *Phys Ther*; Feb 1986.

267. van der Heijden, G. J., van der Windt, D. A., de Winter, A. F. Physiotherapy for patients with soft tissue shoulder disorders: a systematic review of randomised clinical trials. *BMJ*; Jul 5 1997.

268. Nykanen, M. Pulsed ultrasound treatment of the painful shoulder a randomized, double-blind, placebo-controlled study. *Scand J Rehabil Med*; Jun 1995.

269. Van der Heijden, G. J., Leffers, P., Wolters, P. J., Verheijden, J. J., van Mameren, H., Houben, J. P., Bouter, L. M., Knipschild, P. G. No effect of bipolar interferential electrotherapy and pulsed ultrasound for soft tissue shoulder disorders: a randomised controlled trial. *Ann Rheum Dis*; Sep 1999.

270. Ebenbichler, G. R., Erdogmus, C. B., Resch, K. L., Funovics, M. A., Kainberger, F., Barisani, G., Aringer, M., Nicolakis, P., Wiesinger, G. F., Baghestanian, M., Preisinger, E., Fialka-Moser, V. Ultrasound therapy for calcific tendinitis of the shoulder. *N Engl J Med*; May 20 1999.

271. Cole, B.F.,et al. Ultrasound-Guided Versus Blind Subacromial Corticosteroid Injections for Subacromial Impingement Syndrome. *American Journal of Sports Medicine*; 2016.

272. de Witte, P. B., Selten, J. W., Navas, A., Nagels, J., Visser, C. P., Nelissen, R. G., Reijnierse, M. Calcific tendinitis of the rotator cuff: a randomized controlled trial of ultrasound-guided needling and lavage versus subacromial corticosteroids. *Am J Sports Med*; Jul 2013.

273. Gatt, D.L., C.P., Charalambous. Ultrasound-guided barbotage for calcific tendonitis of the shoulder: a systematic review including 908 patients. *Arthroscopy: The Journal of Arthroscopy & Related Surgery*; 2014.

274. Lenza, M., Buchbinder, R., Takwoingi, Y., Johnston, R. V., Hanchard, N. C., Faloppa, F. Magnetic resonance imaging, magnetic resonance arthrography and ultrasonography for assessing rotator cuff tears in people with shoulder pain for whom surgery is being considered. *Cochrane Database Syst Rev*; Sep 24 2013.

275. Ottenheijm, R.P.,et al. Ultrasound-diagnosed disorders in shoulder patients in daily general practice: A retrospective observational study. *BMC Family Practice*; 2014.

276. Rutten, M.J., Jager, G.J., Blickman, J.G. From the RSNA refresher courses: US of the rotator cuff: pitfalls, limitations, and artifacts. *Radiographics*; 2006.

277. Ryu, K.,et al. Ultrasound-Guided Prolotherapy with Polydeoxyribonucleotide for Painful Rotator Cuff Tendinopathy. *Pain Res Manag*; 2018.

278. Saraya, S., Bakry, R. El. Ultrasound: Can it replace MRI in the evaluation of the rotator cuff tears? *Egyptian Journal of Radiology and Nuclear Medicine*; 2016.

279. Wang, J.C.,et al. Ultrasound-Guided Standard vs Dual-Target Subacromial Corticosteroid Injections for Shoulder Impingement Syndrome: A Randomized Controlled Trial. *Arch Phys Med Rehabil*; 2019.

280. Zhang, T.,et al. Efficacy of ultrasound-guided percutaneous lavage for rotator cuff calcific tendinopathy: A systematic review and meta-analysis. *Medicine (Baltimore)*; 2019.

281. Zheng, F.,et al. Role of ultrasound in the detection of rotator-cuff syndrome: An observational study. *Medical Science Monitor*; 2019.

282. Pieber, K.,et al. Long-term course of shoulders after ultrasound therapy for calcific tendinitis: Results of the 10-year follow-up of a randomized controlled trial. *American journal of physical medicine & rehabilitation*; 2018.

283. Shomoto, K.,et al. Effects of ultrasound therapy on calcificated tendinitis of the shoulder. *2002*; Journal of the Japanese Physical Therapy Association.

284. Fitz-Ritson, D. Lasers and their therapeutic applications in chiropractic. *J Can Chropr Assoc*; 2001.

285. Bal, A., Eksioglu, E., Gurcay, E., Gulec, B., Karaahmet, O., Cakci, A. Low-level laser therapy in subacromial impingement syndrome. *Photomed Laser Surg*; Feb 2009.

286. Santamato, A., Solfrizzi, V., Panza, F., Tondi, G., Frisardi, V., Leggin, B. G., Ranieri, M., Fiore, P. Short-term effects of high-intensity laser therapy versus ultrasound therapy in the treatment of people with subacromial impingement syndrome: a randomized clinical trial. *Phys Ther*; Jul 2009.

287. England, S., Farrell, A. J., Coppock, J. S., Struthers, G., Bacon, P. A. Low power laser therapy of shoulder tendonitis. *Scand J Rheumatol*; 1989.

288. Vecchio, P., Cave, M., King, V., Adebajo, A. O., Smith, M., Hazleman, B. L. A double-blind study of the effectiveness of low level laser treatment of rotator cuff tendinitis. *Br J Rheumatol*; Aug 1993.

289. Tumilty, S., Munn, J., McDonough, S., Hurley, D. A., Basford, J. R., Baxter, G. D. Low level laser treatment of tendinopathy: a systematic review with meta-analysis. *Photomed Laser Surg*; Feb 2010.

290. Abrisham, S. M., Kermani-Alghoraishi, M., Ghahramani, R., Jabbari, L., Jomeh, H., Zare, M. Additive effects of low-level laser therapy with exercise on subacromial syndrome: a randomised, double-blind, controlled trial. *Clin Rheumatol*; Oct 2011.

291. Dogan, S. K., Ay, S., Evcik, D. The effectiveness of low laser therapy in subacromial impingement syndrome: a randomized placebo controlled double-blind prospective study. *Clinics (Sao Paulo)*; 2010.

292. Elsodany, Ahmed Mohamed, Alayat, Mohamed Salaheldien Mohamed, Ali, Mohamed Mohamed Ebrahim, Khaprani, Hussien Mosa. Long-term effect of pulsed Nd: YAG laser in the treatment of patients with rotator cuff tendinopathy: a randomized controlled trial. *Photomedicine and laser surgery*; 2018.

293. Haslerud, Sturla, Magnussen, Liv Heide, Joensen, Jon, Lopes-Martins, Rodrigo Alvaro Brandao, Bjordal, Jan Magnus. The efficacy of low-level laser therapy for shoulder tendinopathy: a systematic review and meta-analysis of randomized controlled trials. *Physiotherapy Research International*; 2015.

294. Kelle, Bayram, Kozanoglu, Erkan. Low-level laser and local corticosteroid injection in the treatment of subacromial impingement syndrome: a controlled clinical trial. *Clinical rehabilitation*; 2014.

295. Otadi, Khadijeh, Hadian, Mohammad-Reza, Olyaei, GholamReza, Jalaie, Shohre. The beneficial effects of adding low level laser to ultrasound and exercise in Iranian women with shoulder tendonitis: A randomized clinical trial 1. *Journal of back and musculoskeletal rehabilitation*; 2012.

296. Vidhyadhari, BSL, Mishra, Priyadarshini, Madhavi, K, Nageswararao, MM. Qualitative Analysis of Postural Variations in Adolescent Girls. *Website: www. ijpot. com*; 2016.

297. Yavuz, Ferdi, Duman, Iltekin, Taskaynatan, Mehmet Ali, Tan, Arif Kenan. Low-level laser therapy versus ultrasound therapy in the treatment of subacromial impingement syndrome: a randomized clinical trial. *Journal of back and musculoskeletal rehabilitation*; 2014.

298. Brox, J. I. Regional musculoskeletal conditions: shoulder pain. *Best Pract Res Clin Rheumatol*; Feb 2003.

299. Abdul-Hadi, O.,et al. Nonsteroidal anti-inflammatory drugs in orthopaedics. *J Bone Joint Surg Am*; 2009.

300. AlRuthia, Yazed, Alghadeer, Sultan, Balkhi, Bander, Almalag, Haya M, Alsobayel, Hana, Alodaibi, Faris, Alayoubi, Fakhr, Alkhamali, Amal S, Alshuwairikh, Samar, Alqahtani, Futoun N. Efficacy of acetaminophen versus ibuprofen for the management of rotator cuff-related shoulder pain: Randomized open-label study. *Saudi Pharmaceutical Journal*; 2019.

301. Amroodi, Morteza Nakhaei, Salariyeh, Mostafa. Predictors of failure after conservative treatment of symptomatic partial-thickness rotator cuff tear. *Journal of shoulder and elbow surgery*; 2020.

302. Baring, Toby, Emery, Roger, Reilly, Peter. Management of rotator cuff disease: specific treatment for specific disorders. *Best Practice & Research Clinical Rheumatology*; 2007.

303. Baring, T, Khan, W, Emery, R. Rotator cuff disease: a review of pathophysiology and treatment. *International Journal of Medical and Biological Frontiers*; 2011.

304. Blomquist, Jesper, Solheim, Erik, Liavaag, Sigurd, Baste, V, Havelin, LI. Do nonsteroidal anti-inflammatory drugs affect the outcome of arthroscopic Bankart repair? *Scandinavian journal of medicine & science in sports*; 2014.

305. Boudreault, Jennifer, Desmeules, François, Roy, Jean-Sebastien, Dionne, Clermont, Frémont, Pierre, MacDermid, Joy C. The efficacy of oral non-steroidal anti-inflammatory drugs for rotator cuff tendinopathy: a systematic review and meta-analysis. *Journal of rehabilitation medicine*; 2014.

306. Cho, Chul-Hyun, Song, Kwang-Soon, Min, Byung-Woo, Lee, Kyung-Jae, Ha, Eunyoung, Lee, Yong-Chul, Lee, Young-Kuk. Multimodal approach to postoperative pain control in patients undergoing rotator cuff repair. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2011.

307. Cohen, David B, Kawamura, Sumito, Ehteshami, John R, Rodeo, Scott A. Indomethacin and celecoxib impair rotator cuff tendon-to-bone healing. *The American journal of sports medicine*; 2006.

308. Devereaux, Moira, Velanoski, Kinny Quan, Pennings, Amanda, Elmaraghy, Amr. Short-term effectiveness of precut kinesiology tape versus an NSAID as adjuvant treatment to exercise for subacromial impingement: A randomized controlled trial. *Clinical Journal of Sport Medicine*; 2016.

309. Inderhaug, Eivind, Kollevold, Kristin H, Kalsvik, Maiken, Hegna, Janne, Solheim, Eirik. Preoperative NSAIDs, non-acute onset and long-standing symptoms predict inferior outcome at long-term follow-up after rotator cuff repair. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2017.

310. Lim, Joel Wei-An, Liow, Ming Han, Tan, Andrew Hwee Chye. Post-operative non-steroidal anti-inflammatory drugs do not affect clinical outcomes of rotator cuff repair. *Journal of Orthopaedics*; 2020.

311. Lin, Meng-Ting, Chiang, Ching-Fang, Wu, Chueh-Hung, Huang, Yi-Ting, Tu, Yu-Kang, Wang, Tyng-Guey. Comparative effectiveness of injection therapies in rotator cuff tendinopathy: a systematic review, pairwise and network meta-analysis of randomized controlled trials. *Archives of physical medicine and rehabilitation*; 2019.

312. Nazligul, Tuba, Akpinar, Pinar, Aktas, Ilknur, Unlu, F Ozkan, Cagliyan, H Hartevioglu. The effect of interferential current therapy on patients with subacromial impingement syndrome: a randomized, double-blind, sham-controlled study. *European journal of physical and rehabilitation medicine*; 2018.

313. Oh, Joo Han, Seo, Hyuk Jun, Lee, Ye-Hyun, Choi, Hye-Yeon, Joung, Ho Yun, Kim, Sae Hoon. Do selective COX-2 inhibitors affect pain control and healing after arthroscopic rotator cuff repair? A preliminary study. *The American journal of sports medicine*; 2018.

314. Pérez-Merino, L, Casajuana, MC, Bernal, G, Faba, J, Astilleros, AE, González, R, Giralt, M, Romeu, M, Nogués, MR. Evaluation of the effectiveness of three physiotherapeutic treatments for subacromial impingement syndrome: a randomised clinical trial. *Physiotherapy*; 2016.

315. Petri, Michelle, Hufman, Stephen L, Waser, Gregory, Cui, Harry, Snabes, Michael C, Verburg, Kenneth M. Celecoxib effectively treats patients with acute shoulder tendinitis/bursitis. *The Journal of rheumatology*; 2004.

316. Pipanmekaporn, Tanyong, Punjasawadwong, Yodying, Charuluxananan, Somrat, Lapisatepun, Worawut, Bunburaphong, Pavena, Boonsri, Settapong, Tantraworasin, Apichat, Bunchungmongkol, Nutchanart. The effectiveness of intravenous parecoxib on the incidence of ipsilateral shoulder pain after thoracotomy: A randomized, double-blind, placebo-controlled trial. *Journal of cardiothoracic and vascular anesthesia*; 2018.

317. Sun, Yaying, Chen, Jiwu, Li, Hong, Jiang, Jia, Chen, Shiyi. Steroid injection and nonsteroidal anti-inflammatory agents for shoulder pain: a PRISMA systematic review and meta-analysis of randomized controlled trials. *Medicine*; 2015.

318. Toma, O, Persoons, B, Pogatzki-Zahn, E, Van de Velde, M, Joshi, GP, collaborators, PROSPECT,Working,Group, Schug, S, Kehlet, H, Bonnet, F, Rawal, N. PROSPECT guideline for rotator cuff repair surgery: systematic review and procedure-specific postoperative pain management recommendations. *Anaesthesia*; 2019.

319. van der Sande, Renske, Rinkel, Willem D, Gebremariam, Lukas, Hay, Elaine M, Koes, Bart W, Huisstede, Bionka M. Subacromial impingement syndrome: effectiveness of pharmaceutical interventions–nonsteroidal anti-inflammatory drugs, corticosteroid, or other injections: a systematic review. *Archives of physical medicine and rehabilitation*; 2013.

320. Xu, Jianda, Qu, Yuxing, Li, Huan, Jiang, Tao, Zheng, Chong, Wang, Bin, Shen, Pengfei. Effect of ketorolac in intra-articular injection analgesia for postoperative pain in patients undergoing shoulder arthroscopy: a pilot-controlled clinical study. *Journal of pain research*; 2019.

321. Zheng, Xiao-Qing, Li, Ke, Wei, You-Dong, Tie, Hong-Tao, Yi, Xiao-Yan, Huang, Wei. Nonsteroidal anti-inflammatory drugs versus corticosteroid for treatment of shoulder pain: a systematic review and meta-analysis. *Archives of physical medicine and rehabilitation*; 2014.

322. Wiffen, P., Collins, S., McQuay, H., Carroll, D., Jadad, A., Moore, A. Anticonvulsant drugs for acute and chronic pain. *Cochrane Database Syst Rev*; 2005.

323. Challapalli, V., Tremont-Lukats, I. W., McNicol, E. D., Lau, J., Carr, D. B. Systemic administration of local anesthetic agents to relieve neuropathic pain. *Cochrane Database Syst Rev*; 2005.

324. Bang, Si Ra, Yu, Su Kyung, Kim, Tae Hyeong. Can gabapentin help reduce postoperative pain in arthroscopic rotator cuff repair? A prospective, randomized, double-blind study. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2010.

325. Abbruzzese, G. The medical management of spasticity. *Eur J Neurol*; 2002.

326. Elenbaas, J. K. Centrally acting oral skeletal muscle relaxants. *Am J Hosp Pharm*; Oct 1980.

327. Cherkin, D. C. Primary care research on low back pain. The state of the science. *Spine*; Sep 15 1998.

328. Di Iorio, D., Henley, E., Doughty, A. A survey of primary care physician practice patterns and adherence to acute low back problem guidelines. *Arch Fam Med*; Nov-Dec 2000.

329. van Tulder, M. W., Koes, B. W., Bouter, L. M. Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions. *Spine (Phila Pa 1976)*; Sep 15 1997.

330. Schnitzer, T. J., Ferraro, A., Hunsche, E., Kong, S. X. A comprehensive review of clinical trials on the efficacy and safety of drugs for the treatment of low back pain. *J Pain Symptom Manage*; Jul 2004.

331. Deyo, R. A., Loeser, J. D., Bigos, S. J. Herniated lumbar intervertebral disk. *Ann Intern Med*; Apr 15 1990.

332. Baratta, R. R. A double-blind comparative study of carisoprodol, propoxyphene, and placebo in the management of low back syndrome. *Curr Ther Res Clin Exp*; Sep 1976.

333. Arbus, L, Fajadet, B, Aubert, D,et al. Activity of tetrazepam (myolastan) in low back pain: a double-blind trial v. placebo. *Clin Trials J*; 1990.

334. Preston, EJ, Miller, CB, Herbertson, RK. A double-blind, multicenter trial of methocarbamol (Robaxin®) and cyclobenzaprine (Flexeril®) in acute musculoskeletal conditions. *Today's Therapeutic Trends*; 1984.

335. Chou, R., K., Peterson, M., Helfand. Comparative efficacy and safety of skeletal muscle relaxants for spasticity and musculoskeletal conditions: a systematic review. *Journal of pain and symptom management*; 2004.

336. See, S., R., Ginzburg. Skeletal muscle relaxants. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*; 2008.

337. Bloom, J.E.,et al. Image-guided versus blind glucocorticoid injection for shoulder pain. *Cochrane Database of Systematic Reviews*; 2012.

338. Dean, B.J.F.,et al. The risks and benefits of glucocorticoid treatment for tendinopathy: A systematic review of the effects of local glucocorticoid on tendon. *Seminars in Arthritis & Rheumatism*; 2014.

339. Cumpston, M., Johnston, R. V., Wengier, L., Buchbinder, R. Topical glyceryl trinitrate for rotator cuff disease. *Cochrane Database Syst Rev*; 2009.

340. Ritchie, L. D. A clinical evaluation of flurbiprofen LAT and piroxicam gel: a multicentre study in general practice. *Clin Rheumatol*; May 1996.

341. Lin, J., Zhang, W., Jones, A., Doherty, M. Efficacy of topical non-steroidal anti-inflammatory drugs in the treatment of osteoarthritis: meta-analysis of randomised controlled trials. *BMJ*; Aug 7 2004.

342. Oltean, H.,et al. Herbal medicine for low-back pain. *Cochrane Database of Systematic Reviews*; 2014.

343. Mason, Lorna, Moore, R Andrew, Edwards, Jayne E, Derry, Sheena, McQuay, Henry J. Topical NSAIDs for chronic musculoskeletal pain: systematic review and meta-analysis. *BMC musculoskeletal disorders*; 2004.

344. Derry, Sheena, Conaghan, Philip, Da Silva, Jose Antonio P, Wiffen, Philip J, Moore, R Andrew. Topical NSAIDs for chronic musculoskeletal pain in adults. *Cochrane Database of Systematic Reviews*; 2016.

345. Challoumas, D., Kirwan, P. D., Borysov, D., Clifford, C., McLean, M., Millar, N. L. Topical glyceryl trinitrate for the treatment of tendinopathies: a systematic review. *Br J Sports Med*; Feb 2019.

346. Paoloni, J. A., Appleyard, R. C., Nelson, J., Murrell, G. A. Topical glyceryl trinitrate application in the treatment of chronic supraspinatus tendinopathy: a randomized, double-blinded, placebo-controlled clinical trial. *Am J Sports Med*; Jun 2005.

347. Gammaitoni, A.R.,et al. Predicting response to subacromial injections and lidocaine/tetracaine patch from pretreatment pain quality in patients with shoulder impingement syndrome. *Pain Medicine*; 2015.

348. Jensen, M.P.,et al. The pain quality response profile of a corticosteroid injections and heated lidocaine/tetracaine patch in the treatment of shoulder impingement syndrome. *The Clinical journal of pain*; 2015.

349. Marriott, T.B., M.R., Charney, S., Stanworth. Effects of application durations and heat on the pharmacokinetic properties of drug delivered by a lidocaine/tetracaine patch: a randomized, open-label, controlled study in healthy volunteers. *Clinical therapeutics*; 2012.

350. Radnovich, R. Heated lidocaine-tetracaine patch for management of shoulder impingement syndrome. *Journal of the American Osteopathic Association*; 2013.

351. Radnovich, R., MarriottT.B., . Utility of the heated lidocaine/tetracaine patch in the treatment of pain associated with shoulder impingement syndrome: a pilot study. *International journal of general medicine*; 2013.

352. Radnovich, R., J., Trudeau, A.R., Gammaitoni. A randomized clinical study of the heated lidocaine/tetracaine patch versus subacromial corticosteroid injection for the treatment of pain associated with shoulder impingement syndrome. *Journal of pain research*; 2014.

353. Wallace, M.S.,et al. Evaluation of the depth and duration of anesthesia from heated lidocaine/tetracaine (Synera) patches compared with placebo patches applied to healthy adult volunteers. *Regional Anesthesia & Pain Medicine*; 2010.

354. Kim, J.E.,et al. Analgesic effect of trigger point injection and EMLA for shoulder pain in patients undergoing total laparoscopic hysterectomy: A randomized controlled study. *Medicine*; 2019.

355. Berrazueta, J. R., Losada, A., Poveda, J., Ochoteco, A., Riestra, A., Salas, E., Amado, J. A. Successful treatment of shoulder pain syndrome due to supraspinatus tendinitis with transdermal nitroglycerin. A double blind study. *Pain*; Jul 1996.

356. Gumina, S.,et al. Arginine L-alpha-ketoglutarate, methylsulfonylmethane, hydrolyzed type I collagen and bromelain in rotator cuff tear repair: a prospective randomized study. *Curr Med Res Opin*; 2012.

357. Percy, E.C., J.D., Carson. The use of DMSO in tennis elbow and rotator cuff tendonitis: a double-blind study. *Med Sci Sports Exerc*; 1981.

358. Hudek, R.,et al. Degenerative rotator cuff tears are associated with a low Omega-3 Index. *Prostaglandins, Leukotrienes and Essential Fatty Acids*; 2019.

359. Lewis, JS, Sandford, FM. Rotator cuff tendinopathy: is there a role for polyunsaturated Fatty acids and antioxidants? *Journal of Hand Therapy*; 200*.

360. Sandford, F. M., Sanders, T. A., Wilson, H., Lewis, J. S. A randomised controlled trial of long-chain omega-3 polyunsaturated fatty acids in the management of rotator cuff related shoulder pain. *BMJ Open Sport Exerc Med*; 2018.

361. Cancienne, Jourdan M, Brockmeier, Stephen F, Rodeo, Scott A, Werner, Brian C. Perioperative serum lipid status and statin use affect the revision surgery rate after arthroscopic rotator cuff repair. *The American journal of sports medicine*; 2017.

362. Garcia, Grant H, Liu, Joseph N, Wong, Alexandra, Cordasco, Frank, Dines, David M, Dines, Joshua S, Gulotta, Lawrence V, Warren, Russell. Hyperlipidemia increases the risk of retear after arthroscopic rotator cuff repair. *Journal of shoulder and elbow surgery*; 2017.

363. Zeng, Gerald Joseph ShengXiang, Lee, Merrill Jian Hui, Chen, Jerry Yongqiang, Ang, Benjamin Fu Hong, Hao, Ying, Lie, Denny Tjiauw Tjoen. Dyslipidemia With Perioperative Statin Usage Is Not Associated With Poorer 24-Month Functional Outcomes After Arthroscopic Rotator Cuff Surgery. *The American Journal of Sports Medicine*; 2020.

364. Conti, M, Garofalo, R, Castagna, A. Does a brace influence clinical outcomes after arthroscopic rotator cuff repair? *Musculoskeletal surgery*; 2015.

365. Ghandour, Tarek Mohamed, Ibrahim, Amr, Abdelrahman, Amr A, Elgammal, Ahmed, Hammad, Mohamed Hassan. Does the type of shoulder brace affect postoperative pain and clinical outcome after arthroscopic rotator cuff repair? *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2019.

366. Hollman, Freek, Wolterbeek, Nienke, Zijl, Jacco AC, van Egeraat, Sjoerd PM, Wessel, Ronald N. Abduction brace versus antirotation sling after arthroscopic cuff repair: the effects on pain and function. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2017.

367. Ibrahim, Mahmoud I, Johnson, Aaron J, Pivec, Robert, Issa, Kimona, Naziri, Qais, Kapadia, Bhaveen V, Mont, Michael A. Treatment of adhesive capsulitis of the shoulder with a static progressive stretch device: a prospective, randomized study. *Journal of long-term effects of medical implants*; 2012.

368. Jenssen, Kjersti Kaul, Lundgreen, Kirsten, Madsen, Jan Erik, Kvakestad, Rune, Pripp, Are Hugo, Dimmen, Sigbjørn. No functional difference between three and six weeks of immobilization after arthroscopic rotator cuff repair: A prospective randomized controlled non-inferiority trial. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2018.

369. Rached, Roberto Abi, Rampim, Danielle Bianchini, Yamauti, Rafael Hossamu, Azeka, Meyre Sato, dos Santos, Renata Moraes, Guidolin, Beatriz, Otani, Pericles Tey, Oliveira, Ricardo Bocatto, Castineira, Carolina Pastorin, Martins, Fernanda. Rotator cuff syndrome: Rehabilitation. *Acta Fisiátrica*; 2013.

370. Sheps, David M, Silveira, Anelise, Beaupre, Lauren, Styles-Tripp, Fiona, Balyk, Robert, Lalani, Aleem, Glasgow, Robert, Bergman, Joseph, Bouliane, Martin. Early active motion versus sling immobilization after arthroscopic rotator cuff repair: A randomized controlled trial. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2019.

371. Tirefort, Jérome, Schwitzguebel, Adrien J, Collin, Philippe, Nowak, Alexandra, Plomb-Holmes, Chantal, Lädermann, Alexandre. Postoperative Mobilization After Superior Rotator Cuff Repair: Sling versus No-sling. A Randomized Controlled Trial: Sling versus no-sling after RCR. *Orthopaedic Journal of Sports Medicine*; 2019.

372. Ziegler, Patrick, Stuby, Fabian, Küper, Markus Alexander, Greschner, Thomas, Stöckle, Ulrich, Gühring, Markus. Postoperative Outcome of a New Shoulder Orthesis after Arthroscopic Rotator Cuff Repair: a Prospective, Randomized Observational Study. *Zeitschrift für Orthopädie und Unfallchirurgie*; 2019.

373. Arndt, J, Clavert, P, Mielcarek, P, Bouchaib, J, Meyer, N, Kempf, J-F, Shoulder, French,Society,for, Elbow, . Immediate passive motion versus immobilization after endoscopic supraspinatus tendon repair: a prospective randomized study. *Orthopaedics & Traumatology: Surgery & Research*; 2012.

374. Baumgarten, Keith M, Osborn, Roy, Schweinle III, Will E, Zens, Matthew J. The position of sling immobilization influences the outcomes of anatomic total shoulder arthroplasty: a randomized, single-blind, prospective study. *Journal of shoulder and elbow surgery*; 2018.

375. Hsu, Jason E, Horneff, John G, Gee, Albert O. Immobilization after rotator cuff repair: what evidence do we have now? *Orthopedic Clinics*; 2016.

376. Riboh, Jonathan C, Garrigues, Grant E. Early passive motion versus immobilization after arthroscopic rotator cuff repair. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2014.

377. Shen, Chong, Tang, Zhi-Hong, Hu, Jun-Zu, Zou, Guo-Yao, Xiao, Rong-Chi, Yan, Dong-Xue. Does immobilization after arthroscopic rotator cuff repair increase tendon healing? A systematic review and meta-analysis. *Archives of orthopaedic and trauma surgery*; 2014.

378. van der Meijden, Olivier A, Westgard, Paul, Chandler, Zachary, Gaskill, Trevor R, Kokmeyer, Dirk, Millett, Peter J. Rehabilitation after arthroscopic rotator cuff repair: current concepts review and evidence-based guidelines. *International journal of sports physical therapy*; 2012.

379. Yoo, Jae Chul, Park, Won Hah, Koh, Kyoung Hwan, Kim, Sang Min. Arthroscopic treatment of chronic calcific tendinitis with complete removal and rotator cuff tendon repair. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2010.

380. Copping, J., O'Driscoll, M. Application of tape at the shoulder joint: an effective therapeutic modality for the treatment of impingement syndrome? *Physical Therapy Reviews*; 2005.

381. Alexander, C. M., Harrison, P. J. Reflex connections from forearm and hand afferents to shoulder girdle muscles in humans. *Exp Brain Res*; Feb 2003.

382. Lewis, J. S., Wright, C., Green, A. Subacromial impingement syndrome: the effect of changing posture on shoulder range of movement. *J Orthop Sports Phys Ther*; Feb 2005.

383. Ackermann, B, Adams, R, Marshall, E. The effect of scapula taping on electromyographic activity and musical performance in professional violinists. *Australian Journal of Physiotherapy*; 2001.

384. Thelen, M. D., Dauber, J. A., Stoneman, P. D. The clinical efficacy of kinesio tape for shoulder pain: a randomized, double-blinded, clinical trial. *J Orthop Sports Phys Ther*; Jul 2008.

385. Kaya, E., Zinnuroglu, M., Tugcu, I. Kinesio taping compared to physical therapy modalities for the treatment of shoulder impingement syndrome. *Clin Rheumatol*; Apr 30 2010.

386. Zanella, P, Willey, S, Seibel, S, Hughes, C. The effect of scapular taping on shoulder joint repositioning. *Journal of Sport Rehabilitation*; 2001.

387. Pogliaghi, S. A new taping technique for shoulder impingement. A pilot study. *Europa Medicophysica*; 1998.

388. Cools, A. M., Witvrouw, E. E., Danneels, L. A., Cambier, D. C. Does taping influence electromyographic muscle activity in the scapular rotators in healthy shoulders? *Man Ther*; Aug 2002.

389. Baquie, P. Upper limb taping. *Aust Fam Physician*; Apr 2002.

390. Host, H. H. Scapular taping in the treatment of anterior shoulder impingement. *Phys Ther*; Sep 1995.

391. Smith, M., Sparkes, V., Busse, M., Enright, S. Upper and lower trapezius muscle activity in subjects with subacromial impingement symptoms: is there imbalance and can taping change it? *Phys Ther Sport*; May 2009.

392. Hsu, Y. H., Chen, W. Y., Lin, H. C., Wang, W. T., Shih, Y. F. The effects of taping on scapular kinematics and muscle performance in baseball players with shoulder impingement syndrome. *J Electromyogr Kinesiol*; Dec 2009.

393. Miller, P., Osmotherly, P. Does scapula taping facilitate recovery for shoulder impingement symptoms? A pilot randomized controlled trial. *J Man Manip Ther*; 2009.

394. Hadala, M., Barrios, C. Different strategies for sports injury prevention in an America's Cup yachting crew. *Med Sci Sports Exerc*; Aug 2009.

395. Patel, Manish A, Gadsden, Jeffrey C, Nedeljkovic, Srdjan S, Bao, Xiaodong, Zeballos, Jose L, Yu, Vincent, Ayad, Sabry S, Bendtsen, Thomas F. Brachial plexus block with liposomal bupivacaine for shoulder surgery improves analgesia and reduces opioid consumption: results from a multicenter, randomized, double-blind, controlled trial. *Pain Medicine*; 2020.

396. Walsh, S. F. Treatment of a brachial plexus injury using kinesiotape and exercise. *Physiother Theory Pract*; Oct 2010.

397. Yoshida, A., Kahanov, L. The effect of kinesio taping on lower trunk range of motions. *Res Sports Med*; Apr-Jun 2007.

398. Kalichman, L., Vered, E., Volchek, L. Relieving symptoms of meralgia paresthetica using Kinesio taping: a pilot study. *Arch Phys Med Rehabil*; Jul 2010.

399. Lin, VW, Hsiao, I, Kingery, WS. High intensity magnetic stimulation over the lumbosacral spine evokes antinociception in rats. *Clin Neurophysiol*; 2002.

400. Binder, A, Parr, G., Hazleman, B, Fitton-Jackson, S. Pulsed electromagnetic field therapy of persistent rotator cuff tendinitis. A double-blind controlled assessment. *Lancet*; 1984.

401. de Freitas, D Galace, Monteiro, Renan Lima, Marcondes, Freddy Beretta, Fukuda, Thiago Yukio, Fucs, Patrícia Maria de Moraes Barros. Pulsed electromagnetic field in patients with shoulder impingement syndrome. *J Applied Res*; 2013.

402. Klüter, Tim, Krath, André, Stukenberg, Martin, Gollwitzer, Hans, Harrasser, Norbert, Knobloch, Karsten, Maffulli, Nicola, Hausdorf, Jörg, Gerdesmeyer, Ludger. Electromagnetic transduction therapy and shockwave therapy in 86 patients with rotator cuff tendinopathy: A prospective randomized controlled trial. *Electromagnetic Biology and Medicine*; 2018.

403. Osti, L, Buono, Del, Maffulli, AN. Pulsed electromagnetic fields after rotator cuff repair: a randomized, controlled study. *Orthopedics*; 2015.

404. Dalbøge, A.,et al. Cumulative occupational shoulder exposures and surgery for subacromial impingement syndrome: a nationwide Danish cohort study. *Occupational and environmental medicine*; 2014.

405. Hand, J., Verscheure, S., Osternig, L. A comparison of whole-body vibration and resistance training on total work in the rotator cuff. *J Athl Train*; Sep-Oct 2009.

406. Joseph, L.,et al. Prevalence of musculoskeletal pain among professional drivers: A systematic review. *Journal of occupational health*; 2020.

407. Kuppens, K.,et al. Sensory processing and central pain modulation in patients with chronic shoulder pain: A case-control study. *Scandinavian journal of medicine & science in sports*; 2018.

408. Lam, P. H., Hansen, K., Keighley, G., Hackett, L., Murrell, G. A. A Randomized, Double-Blinded, Placebo-Controlled Clinical Trial Evaluating the Effectiveness of Daily Vibration After Arthroscopic Rotator Cuff Repair. *Am J Sports Med*; Nov 2015.

409. Seidler, A., Romero Starke, K., Freiberg, A., Hegewald, J., Nienhaus, A., Bolm-Audorff, U. Dose-Response Relationship between Physical Workload and Specific Shoulder Diseases-A Systematic Review with Meta-Analysis. *Int J Environ Res Public Health*; Feb 14 2020.

410. Aktas I, Akgun K,Cakmak B. Therapeutic effect of pulsed electromagnetic field in conservative treatment of subacromial impingement syndrome. *Clin Rheumato*; 2007.

411. Chard, M.D. Hazleman,B.L. Devereaux,M.D. Controlled study to investigate dose-response patterns to portable pulsed electromagnetic field in the treatment of rotator cuff tendinitis. *Journal of Orthopaedic Rheumatology*; 1988.

412. Gebremariam L, Hay EM,van der Sande R,Rinkel WD,Koes BW,Huisstede BM. Subacromial impingement syndrome--effectiveness of physiotherapy and manual therapy. *Br J Sports Med*; 2014.

413. Haik MN, et al. Effectiveness of physical therapy treatment of clearly defined subacromial pain: a systematic review of randomised controlled trials. *Br J Sports Med*; 2016.

414. Osti L, Del Buono A,Maffulli N,Denaro V. Early efficacy of pulsed electromagnetic fields in the management of rotator cuff tear a randomized controlled trial. *Muscles, Ligaments & Tendons Journal*; 2012.

415. Reinold MM, et al. The effect of neuromuscular electrical stimulation of the infraspinatus on shoulder external rotation force production after rotator cuff repair surger. *American journal of sports medicine*; 2008.

416. Miranda, H., Viikari-Juntura, E., Heistaro, S., Heliovaara, M., Riihimaki, H. A population study on differences in the determinants of a specific shoulder disorder versus nonspecific shoulder pain without clinical findings. *Am J Epidemiol*; May 1 2005.

417. Wendelboe, A. M., Hegmann, K. T., Gren, L. H., Alder, S. C., White, G. L.,Jr., Lyon, J. L. Associations between body-mass index and surgery for rotator cuff tendinitis. *J Bone Joint Surg Am*; Apr 2004.

418. Skov, T., Borg, V., Orhede, E. Psychosocial and physical risk factors for musculoskeletal disorders of the neck, shoulders, and lower back in salespeople. *Occup Environ Med*; May 1996.

419. Stenlund, B., Goldie, I., Hagberg, M., Hogstedt, C. Shoulder tendinitis and its relation to heavy manual work and exposure to vibration. *Scand J Work Environ Health*; Feb 1993.

420. Luime, Jolanda J, Kuiper, Judith I, Koes, Bart W, Verhaar, Jan AN, Miedema, Harald S, Burdorf, Alex. Work-related risk factors for the incidence and recurrence of shoulder and neck complaints among nursing-home and elderly-care workers. *Scandinavian journal of work, environment & health*; 2004.

421. Kane, S. M., Dave, A., Haque, A., Langston, K. The incidence of rotator cuff disease in smoking and non-smoking patients: a cadaveric study. *Orthopedics*; Apr 2006.

422. Kaergaard, Anette, Hansen, Åse M, Rasmussen, Kurt, Andersen, Johan H. Association between plasma testosterone and work-related neck and shoulder disorders among female workers. *Scandinavian journal of work, environment & health*; 2000.

423. Applegate, Kara Arnold, Thiese, Matthew S, Merryweather, Andrew S, Kapellusch, Jay, Drury, David L, Wood, Eric, Kendall, Richard, Foster, James, Garg, Arun, Hegmann, Kurt T. Association between cardiovascular disease risk factors and rotator cuff tendinopathy: a cross-sectional study. *Journal of occupational and environmental medicine*; 2017.

424. Atya, A.M. Efficacy of microcurrent electrical stimulation on pain, proprioception accuracy and functional disability in subacromial impingement: RCT. *Physiotherapy and Occupational Therapy*; 2012.

425. Vrouva, S.,et al. Comparative study of pain relief in two non-pharmacological treatments in patients with partial rotator cuff tears: A randomized trial. *Anesthesiology and Pain Medicine*; 2019.

426. García, I.,et al. Comparative effectiveness of ultrasonophoresis and iontophoresis in impingement syndrome: a double-blind, randomized, placebo controlled trial. *Clinical rehabilitation*; 2016.

427. Leduc, B.E.,et al. Treatment of calcifying tendinitis of the shoulder by acetic acid iontophoresis: a double-blind randomized controlled trial. *Archives of physical medicine and rehabilitation*; 2003.

428. Blum, K., Chen, A. L., Chen, T. J., Waite, R. L., Downs, B. W., Braverman, E. R., Kerner, M. M., Savarimuthu, S. M., DiNubile, N. Repetitive H-wave device stimulation and program induces significant increases in the range of motion of post operative rotator cuff reconstruction in a double-blinded randomized placebo controlled human study. *BMC Musculoskelet Disord*; 2009.

429. Huisstede, B. M., Koes, B. W., Gebremariam, L., Keijsers, E., Verhaar, J. A. Current evidence for effectiveness of interventions to treat rotator cuff tears. *Man Ther*; Jun 2011.

430. McDowell, B.C.,et al. Comparative analgesic effects of H-wave therapy and transcutaneous electrical nerve stimulation on pain threshold in humans. *Archives of physical medicine and rehabilitation*; 1999.

431. Ahmad, E.T. High-voltage pulsed galvanic stimulation: effect of treatment duration on healing of chronic pressure ulcers. *Annals of burns and fire disasters*; 2008.

432. Kaya, D.,et al. High voltage pulsed galvanic stimulation adjunct to rehabilitation program for patellofemoral pain syndrome: a prospective randomized controlled trial. *Turk J Physiother Rehabil*; 2013.

433. El-sayed, A.G.,et al. Percutaneous electrical nerve stimulation: an alternative to TENS in the management of sciatica. *Pain*; 1999.

434. Hamza, M.A.,et al. Percutaneous electrical nerve stimulation: a novel analgesic therapy for diabetic neuropathic pain. *Diabetes care*; 2000.

435. Weiner, D.K.,et al. Efficacy of percutaneous electrical nerve stimulation for the treatment of chronic low back pain in older adults. *Journal of the American Geriatrics Society*; 2003.

436. Adebajo, A. O., Nash, P., Hazleman, B. L. A prospective double blind dummy placebo controlled study comparing triamcinolone hexacetonide injection with oral diclofenac 50 mg TDS in patients with rotator cuff tendinitis. *J Rheumatol*; Sep 1990.

437. Petri, M., Dobrow, R., Neiman, R., Whiting-O'Keefe, Q., Seaman, W. E. Randomized, double-blind, placebo-controlled study of the treatment of the painful shoulder. *Arthritis Rheum*; Sep 1987.

438. van der Windt, D. A., Koes, B. W., de Jong, B. A., Bouter, L. M. Shoulder disorders in general practice: incidence, patient characteristics, and management. *Ann Rheum Dis*; Dec 1995.

439. Park, J. H., Lee, Y. S., Wang, J. H., Noh, H. K., Kim, J. G. Outcome of the isolated SLAP lesions and analysis of the results according to the injury mechanisms. *Knee Surg Sports Traumatol Arthrosc*; May 2008.

440. Buchbinder, R., Green, S., Youd, J. M. Corticosteroid injections for shoulder pain. *Cochrane Database Syst Rev*; 2003.

441. Goupille, P., Sibilia, J. Local corticosteroid injections in the treatment of rotator cuff tendinitis (except for frozen shoulder and calcific tendinitis). Groupe Rhumatologique Francais de l'Epaule (G.R.E.P.). *Clin Exp Rheumatol*; Sep-Oct 1996.

442. Bell, Allen D, Conaway, Doug. Corticosteroid injections for painful shoulders. *International journal of clinical practice*; 2005.

443. van der Heijden, G. J., van der Windt, D. A., Kleijnen, J., Koes, B. W., Bouter, L. M. Steroid injections for shoulder disorders: a systematic review of randomized clinical trials. *Br J Gen Pract*; May 1996.

444. Cacchio, A., De Blasis, E., Desiati, P., Spacca, G., Santilli, V., De Paulis, F. Effectiveness of treatment of calcific tendinitis of the shoulder by disodium EDTA. *Arthritis Rheum*; Jan 15 2009.

445. Chou, W.-Y.,et al. Effect of sodium hyaluronate treatment on rotator cuff lesions without complete tears: a randomized, double-blind, placebo-controlled study. *Journal of shoulder and elbow surgery*; 2010.

446. Flores, C.,et al. Efficacy and tolerability of peritendinous hyaluronic acid in patients with supraspinatus tendinopathy: a multicenter, randomized, controlled trial. *Sports medicine-open*; 2017.

447. Penning, LI, de Bie, RA, Walenkamp, G.H. Subacromial triamcinolone acetonide, hyaluronic acid and saline injections for shoulder pain an RCT investigating the effectiveness in the first days. *BMC musculoskeletal disorders*; 2014.

448. Saggini, R.,et al. Viscosupplementation with hyaluronic acid or polynucleotides: Results and hypothesis for condro-synchronization. *J Clin Trials*; 2014.

449. Kim, Y. S., Park, J. Y., Lee, C. S., Lee, S. J. Does hyaluronate injection work in shoulder disease in early stage? A multicenter, randomized, single blind and open comparative clinical study. *J Shoulder Elbow Surg*; Jun 2012.

450. Noël, E.,et al. Efficacy and safety of Hylan GF 20 in shoulder osteoarthritis with an intact rotator cuff. Open-label prospective multicenter study. *Joint Bone Spine*; 2009.

451. Lee, Lin-Chien, Lieu, Fu-Kong, Lee, Hung-Lin, Tung, Tao-Hsin. Effectiveness of hyaluronic acid administration in treating adhesive capsulitis of the shoulder: a systematic review of randomized controlled trials. *BioMed research international*; 2015.

452. Honvo, G.,et al. Safety of intra-articular hyaluronic acid injections in osteoarthritis: outcomes of a systematic review and meta-analysis. *Drugs & aging*; 2019.

453. Saito, S, Furuya, T, Kotake, S. Therapeutic effects of hyaluronate injections in patients with chronic painful shoulder: A meta-analysis of randomized controlled trials. *Arthritis care & research*; 2010.

454. Tagliafico, A.,et al. Ultrasound-guided interventional procedures around the shoulder. *La radiologia medica*; 2014.

455. Sengul, L, Oz, B, Yolerl, O, Olmez, N, Memis, A, Uluc, E. Sodium hyaluronate injections compared to local modalities for the treatment of shoulder impingement syndrome. *Turk J Phys Med Rehab*; 2008.

456. Albert, J. D., Meadeb, J., Guggenbuhl, P., Marin, F., Benkalfate, T., Thomazeau, H., Chales, G. High-energy extracorporeal shock-wave therapy for calcifying tendinitis of the rotator cuff: a randomised trial. *J Bone Joint Surg Br*; Mar 2007.

457. Krasny, C., Enenkel, M., Aigner, N., Wlk, M., Landsiedl, F. Ultrasound-guided needling combined with shock-wave therapy for the treatment of calcifying tendonitis of the shoulder. *J Bone Joint Surg Br*; Apr 2005.

458. Farin, PU, Räsänen, Heikki, Jaroma, Heikki, Harju, Arvi. Rotator cuff calcifications: treatment with ultrasound-guided percutaneous needle aspiration and lavage. *Skeletal radiology*; 1996.

459. Maugars, Y., Varin, S., Gouin, F., Huguet, D., Rodet, D., Nizard, J., N'Guyen, J. M., Guillot, P., Glemarec, J., Passutti, N., Berthelot, J. M. Treatment of shoulder calcifications of the cuff: a controlled study. *Joint Bone Spine*; Jul 2009.

460. Arias-Buría, José L, Fernández-de-Las-Peñas, César, Palacios-Ceña, María, Koppenhaver, Shane L, Salom-Moreno, Jaime. Exercises and dry needling for subacromial pain syndrome: A randomized parallel-group trial. *The Journal of Pain*; 2017.

461. De Boer, Friso A, Mocking, Femke, Nelissen, Eelco M, Van Kampen, Paulien M, Huijsmans, Pol E. Ultrasound guided needling vs radial shockwave therapy in calcific tendinitis of the shoulder: a prospective randomized trial. *Journal of orthopaedics*; 2017.

462. de Witte, Pieter Bas, Kolk, Arjen, Overes, Ferdinand, Nelissen, Rob GHH, Reijnierse, Monique. Rotator cuff calcific tendinitis: ultrasound-guided needling and lavage versus subacromial corticosteroids: five-year outcomes of a randomized controlled trial. *The American journal of sports medicine*; 2017.

463. Halle, Rob, Crowell, Michael, Goss, Donald. Dry needling and physical therapy versus physical therapy alone following shoulder stabilization repair: a randomized clinical trial. *International journal of sports physical therapy*; 2020.

464. Hurley, Eoghan T, Hannon, Charles P, Pauzenberger, Leo, Fat, Daren Lim, Moran, Cathal J, Mullett, Hannan. Nonoperative treatment of rotator cuff disease with platelet-rich plasma: a systematic review of randomized controlled trials. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2019.

465. Kamali, Fahimeh, Sinaei, Ehsan, Morovati, Maryam. Comparison of upper trapezius and infraspinatus myofascial trigger point therapy by dry needling in overhead athletes with unilateral shoulder impingement syndrome. *Journal of sport rehabilitation*; 2019.

466. Salom-Moreno, Jaime, Jiménez-Gómez, Laura, Gómez-Ahufinger, Victoria, Palacios-Ceña, María, Arias-Buría, José L, Koppenhaver, Shane L, Fernández-de-las-Peñas, César. Effects of low-load exercise on postneedling-induced pain after dry needling of active trigger point in individuals with subacromial pain syndrome. *PM&R*; 2017.

467. Tsikopoulos, Konstantinos, Tsikopoulos, Ioannis, Simeonidis, Evangelos, Papathanasiou, Efthymia, Haidich, Anna-Bettina, Anastasopoulos, Nikolaos, Natsis, Konstantinos. The clinical impact of platelet-rich plasma on tendinopathy compared to placebo or dry needling injections: A meta-analysis. *Physical Therapy in Sport*; 2016.

468. Weiss, Leigh J, Wang, Dean, Hendel, Michael, Buzzerio, Philip, Rodeo, Scott A. Management of rotator cuff injuries in the elite athlete. *Current reviews in musculoskeletal medicine*; 2018.

469. Kesikburun, Serdar, Tan, Arif Kenan, Yılmaz, Bilge, Yaşar, Evren, Yazıcıoğlu, Kamil. Platelet-rich plasma injections in the treatment of chronic rotator cuff tendinopathy: a randomized controlled trial with 1-year follow-up. *The American journal of sports medicine*; 2013.

470. Mofrad, M.K.,et al. Periarticular Neurofascial Dextrose Prolotherapy Versus Physiotherapy for the Treatment of Chronic Rotator Cuff Tendinopathy: Randomized Clinical Trial. *JCR: Journal of Clinical Rheumatology*; 2020.

471. Cole, Brandi, Lam, Patrick, Hackett, Lisa, Murrell, George AC. Ultrasound-guided injections for supraspinatus tendinopathy: corticosteroid versus glucose prolotherapy–a randomized controlled clinical trial. *Shoulder & elbow*; 2018.

472. Amanollahi, Asadollah, Asheghan, Mahsa, Hashemi, Seyed Ebrahim. Subacromial corticosteroid injection versus subcutaneous 5% dextrose in patients with chronic rotator cuff tendinopathy: A short-term randomized clinical trial. *Interventional Medicine and Applied Science*; 2019.

473. Bertrand, Helene, Reeves, Kenneth Dean, Bennett, Cameron J, Bicknell, Simon, Cheng, An-Lin. Dextrose prolotherapy versus control injections in painful rotator cuff tendinopathy. *Archives of physical medicine and rehabilitation*; 2016.

474. Catapano, M.,et al. Effectiveness of Dextrose Prolotherapy for Rotator Cuff Tendinopathy: A Systematic Review. *PM&R*; 2020.

475. Chang, Yu-Ju, Chang, Feng-Hang, Hou, Peng-Hsuan, Tseng, Kai-Hsiang, Lin, Yen-Nung. Effects of Hyperosmolar Dextrose Injection in Patients With Rotator Cuff Disease and Bursitis: A Randomized Controlled Trial. *Archives of Physical Medicine and Rehabilitation*; 2021.

476. George, J.,et al. Comparative Effectiveness of Ultrasound-Guided Intratendinous Prolotherapy Injection with Conventional Treatment to Treat Focal Supraspinatus Tendinosis. *Scientifica*; 2018.

477. Lin, C-L: Huang,C-C, Huang, S-W. Effects of hypertonic dextrose injection in chronic supraspinatus tendinopathy of the shoulder: a randomized placebo-controlled trial. *European journal of physical and rehabilitation medicine*; 2018.

478. Seven, M.,et al. Effectiveness of prolotherapy in the treatment of chronic rotator cuff lesions. *Orthopaedics & Traumatology: Surgery & Research*; 2017.

479. Abildgaard, Jeffrey T, Lonergan, Keith T, Tolan, Stefan J, Kissenberth, Michael J, Hawkins, Richard J, Washburn III, Richard, Adams, Kyle J, Long, Catherine D, Shealy, E Carlisle, Motley, Jay R. Liposomal bupivacaine versus indwelling interscalene nerve block for postoperative pain control in shoulder arthroplasty: a prospective randomized controlled trial. *Journal of Shoulder and Elbow Surgery*; 2017.

480. Kolade, Oluwadamilola, Patel, Karan, Ihejirika, Rivka, Press, Daniel, Friedlander, Scott, Roberts, Timothy, Rokito, Andrew S, Virk, Mandeep S. Efficacy of liposomal bupivacaine in shoulder surgery: a systematic review and meta-analysis. *Journal of shoulder and elbow surgery*; 2019.

481. Malige, Ajith, Yeazell, Shawn, Ng-Pellegrino, Anna, Carolan, Gregory. Risk Factors for Complications and Return to the Emergency Department after Interscalene Block Using Liposomal Bupivacaine for Shoulder Surgery. *Journal of Shoulder and Elbow Surgery*; 2020.

482. Mandava, Nikhil K, Sethi, Paul M, Routman, Howard D, Liddy, Nicole, Haidamous, Georges, Denard, Patrick J. Opioid Requirement After Rotator Cuff Repair is Low With a Multimodal Approach to Pain. *Journal of Shoulder and Elbow Surgery*; 2020.

483. Namdari, Surena, Nicholson, Thema, Abboud, Joseph, Lazarus, Mark, Steinberg, Dean, Williams, Gerald. Randomized controlled trial of interscalene block compared with injectable liposomal bupivacaine in shoulder arthroplasty. *JBJS*; 2017.

484. Fu, F. H., Harner, C. D., Klein, A. H. Shoulder impingement syndrome. A critical review. *Clin Orthop Relat Res*; Aug 1991.

485. Sabesan, Vani J, Shahriar, Rajin, Petersen-Fitts, Graysen R, Whaley, James D, Bou-Akl, Therese, Sweet, Matthew, Milia, Marc. A prospective randomized controlled trial to identify the optimal postoperative pain management in shoulder arthroplasty: liposomal bupivacaine versus continuous interscalene catheter. *Journal of Shoulder and Elbow Surgery*; 2017.

486. Sethi, Paul M, Brameier, Devon T, Mandava, Nikhil K, Miller, Seth R. Liposomal bupivacaine reduces opiate consumption after rotator cuff repair in a randomized controlled trial. *Journal of Shoulder and Elbow Surgery*; 2019.

487. Verdecchia, Nicole M, Rodosky, Mark W, Kentor, Michael, Orebaugh, Steven L. Liposomal bupivacaine infiltration in the surgical site for analgesia after rotator cuff repair: a randomized, double blinded, placebo-controlled trial. *Journal of Shoulder and Elbow Surgery*; 2020.

488. Wang, Kun, Zhang, Hong-xia. Liposomal bupivacaine versus interscalene nerve block for pain control after total shoulder arthroplasty: a systematic review and meta-analysis. *International Journal of Surgery*; 2017.

489. Centeno, Christopher, Fausel, Zachary, Stemper, Ian, Azuike, Ugochi, Dodson, Ehren. A randomized controlled trial of the treatment of rotator cuff tears with bone marrow concentrate and platelet products compared to exercise therapy: A midterm analysis. *Stem cells international*; 2020.

490. Chen, Xiao, Jones, Ian A, Togashi, Ryan, Park, Caron, Vangsness Jr, C Thomas. Use of platelet-rich plasma for the improvement of pain and function in rotator cuff tears: a systematic review and meta-analysis with bias assessment. *The American journal of sports medicine*; 2020.

491. Cole, Brian J, Verma, Nikhil N, Yanke, Adam Blair, Bach, Bernard R, Otte, Robert Stephen, Chubinskaya, Susan, Romeo, Anthony A, Southworth, Taylor Marie, Naveen, Neal Bhojraj. Prospective randomized trial of biologic augmentation with mesenchymal stem cells in patientsundergoing arthroscopic rotator cuff repair. *Orthopaedic Journal of Sports Medicine*; 2019.

492. Hurd, Jason L, Facile, Tiffany R, Weiss, Jennifer, Hayes, Matthew, Hayes, Meredith, Furia, John P, Maffulli, Nicola, Winnier, Glenn E, Alt, Christopher, Schmitz, Christoph. Safety and efficacy of treating symptomatic, partial-thickness rotator cuff tears with fresh, uncultured, unmodified, autologous adipose-derived regenerative cells (UA-ADRCs) isolated at the point of care: a prospective, randomized, controlled first-in-human pilot study. *Journal of Orthopaedic Surgery and Research*; 2020.

493. Jo, Chris Hyunchul, Chai, Jee Won, Jeong, Eui Cheol, Oh, Sohee, Yoon, Kang Sup. Intratendinous injection of mesenchymal stem cells for the treatment of rotator cuff disease: A 2-year follow-up study. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2020.

494. Lamas, José Ramón, García-Fernández, Carlos, Tornero-Esteban, Pilar, López, Yaiza, Rodriguez-Rodriguez, Luis, Ortega, Luis, Fernández-Gutiérrez, Benjamín, Marco, Fernando. Adverse effects of xenogenic scaffolding in the context of a randomized double-blind placebo-controlled study for repairing full-thickness rotator cuff tears. *Trials*; 2019.

495. Liu, Fanxiao, Meng, Qingqi, Yin, Heyong, Yan, Zexing. Stem Cells in Rotator Cuff Injuries and Reconstructions: A systematic review and meta-analysis. *Current Stem Cell Research & Therapy*; 2019.

496. Pas, Haiko IMFL, Moen, Maarten H, Haisma, Hidde J, Winters, Marinus. No evidence for the use of stem cell therapy for tendon disorders: a systematic review. *British journal of sports medicine*; 2017.

497. Tsekes, Dimitrios, Konstantopoulos, Georgios, Khan, Wasim S, Rossouw, Daniel, Elvey, Mike, Singh, Jagwant. Use of stem cells and growth factors in rotator cuff tendon repair. *European Journal of Orthopaedic Surgery & Traumatology*; 2019.

498. van den Boom, Noortje Anna Clasina, Winters, Marinus, Haisma, Hidde Jacobs, Moen, Maarten Hendrik. Efficacy of Stem Cell Therapy for Tendon Disorders: A Systematic Review. *Orthopaedic Journal of Sports Medicine*; 2020.

499. Zumstein, Matthias, Rumian, A, Thelu, CE, Lesbats, V, O'Shea, K, Schaer, M, Boileau, P. Use of platelet-and leucocyte-rich fibrin (L-PRF) does not affect late rotator cuff tendon healing. A prospective randomized controlled study. 2012.

500. Boneti, C., Arentz, C., Klimberg, V. S. Scapulothoracic bursitis as a significant cause of breast and chest wall pain: underrecognized and undertreated. *Ann Surg Oncol*; Oct 2010.

501. Bron, C., Dommerholt, J., Stegenga, B., Wensing, M., Oostendorp, R. A. High prevalence of shoulder girdle muscles with myofascial trigger points in patients with shoulder pain. *BMC Musculoskeletal Disorders*; 2011.

502. Gobel, H., Heinze, A., Reichel, G., Hefter, H., Benecke, R. Efficacy and safety of a single botulinum type A toxin complex treatment (Dysport) for the relief of upper back myofascial pain syndrome: results from a randomized double-blind placebo-controlled multicentre study. *Pain*; Nov 2006.

503. Hawk, C., Minkalis, A. L., Khorsan, R., Daniels, C. J., Homack, D., Gliedt, J. A., Hartman, J. A., Bhalerao, S. Systematic Review of Nondrug, Nonsurgical Treatment of Shoulder Conditions. *Journal of Manipulative and Physiological Therapeutics*; 2017.

504. Hsu, P. C., Wu, W. T., Han, D. S., Chang, K. V. Comparative effectiveness of botulinum toxin injection for chronic shoulder pain: A meta-analysis of randomized controlled trials. *Toxins*; 2020.

505. Kassolik, K.,et al. Recommendations of the polish society of physiotherapy, polish society of family medicine and college of family physicians in Poland in the scope of physiotherapy in painful shoulder syndrome in primary healthcare. *Family Medicine and Primary Care Review*; 2018.

506. Kim, D. Y., Kim, J. M. Safety and Efficacy of PrabotulinumtoxinA (Nabota(®)) Injection for Cervical and Shoulder Girdle Myofascial Pain Syndrome: A Pilot Study. *Toxins (Basel)*; Sep 3 2018.

507. Liu, L., Huang, Q. M., Liu, Q. G., Ye, G., Bo, C. Z., Chen, M. J., Li, P. Effectiveness of dry needling for myofascial trigger points associated with neck and shoulder pain: a systematic review and meta-analysis. *Arch Phys Med Rehabil*; May 2015.

508. Lugo, L. H., García, H. I., Rogers, H. L., Plata, J. A. Treatment of myofascial pain syndrome with lidocaine injection and physical therapy, alone or in combination: a single blind, randomized, controlled clinical trial. *BMC Musculoskelet Disord*; Feb 24 2016.

509. Nicol, A. L., Wu,II, Ferrante, F. M. Botulinum toxin type a injections for cervical and shoulder girdle myofascial pain using an enriched protocol design. *Anesth Analg*; Jun 2014.

510. Oh, Joo Han, Chung, Seok Won, Oh, Kyung-Soo, Yoo, Jae Chul, Jee, Wonhee, Choi, Jung-Ah, Kim, Yang-Soo, Park, Jin-Young. Effect of recombinant human growth hormone on rotator cuff healing after arthroscopic repair: preliminary result of a multicenter, prospective, randomized, open-label blinded end point clinical exploratory trial. *Journal of shoulder and elbow surgery*; 2018.

511. Lane, Thomas A, Ho, Anthony D, Bashey, Asad, Peterson, Sandra, Young, Dennis, Law, Ping. Mobilization of blood-derived stem and progenitor cells in normal subjects by granulocyte-macrophage-and granulocyte-colony-stimulating factors. *Transfusion*; 1999.

512. Ross, David, Maerz, Tristan, Kurdziel, Michael, Hein, Joel, Doshi, Shashin, Bedi, Asheesh, Anderson, Kyle, Baker, Kevin. The effect of granulocyte-colony stimulating factor on rotator cuff healing after injury and repair. *Clinical Orthopaedics and Related Research®*; 2015.

513. Chae, Sang Hoon, Won, Jae Yeon, Yoo, Jae Chul. Clinical outcome of ultrasound-guided atelocollagen injection for patients with partial rotator cuff tear in an outpatient clinic: a preliminary study. *Clinics in Shoulder and Elbow*; 2020.

514. Kim, In Bo, Kim, Eun Yeol, Lim, Kuk Pil, Heo, Ki Seong. Does the Use of Injectable Atelocollagen during Arthroscopic Rotator Cuff Repair Improve Clinical and Structural Outcomes? *Clinics in Shoulder and Elbow*; 2019.

515. Kim, Jong-Ho, Kim, Dong-Jin, Lee, Hyo-Jin, Kim, Baek-Kyu, Kim, Yang-Soo. Atelocollagen injection improves tendon integrity in partial-thickness rotator cuff tears: A prospective comparative study. *Orthopaedic journal of sports medicine*; 2020.

516. Cai, Y.Z.,et al. Arthroscopic Rotator Cuff Repair With Graft Augmentation of 3-Dimensional Biological Collagen for Moderate to Large Tears: A Randomized Controlled Study. *Am J Sports Med*; 2018.

517. Greenall, G.,et al. Systematic review of the surgical management of rotator cuff repair with an augmentative patch: a feasibility study protocol. *Syst Rev*; 2018.

518. Badhe, S.P.,et al. An assessment of porcine dermal xenograft as an augmentation graft in the treatment of extensive rotator cuff tears. *J Shoulder Elbow Surg*; 2008.

519. Iannotti, J. P., Codsi, M. J., Kwon, Y. W., Derwin, K., Ciccone, J., Brems, J. J. Porcine small intestine submucosa augmentation of surgical repair of chronic two-tendon rotator cuff tears. A randomized, controlled trial. *J Bone Joint Surg Am*; Jun 2006.

520. D'Ambrosi, R.,et al. Retears and complication rates after arthroscopic rotator cuff repair with scaffolds: a systematic review. *Cell Tissue Bank*; 2019.

521. Harniman, E., Carette, S., Kennedy, C., Beaton, D. Extracorporeal shock wave therapy for calcific and noncalcific tendonitis of the rotator cuff: a systematic review. *J Hand Ther*; Apr-Jun 2004.

522. Johnson, S. M., Cherry, J. V., Thomas, N., Jafri, M., Jariwala, A., McLeod, G. G. Clinical outcomes and ultrasonographic viability of GraftJacket(R) augmented rotator cuff repair: a prospective follow-up study with mean follow-up of forty-one months. *J Clin Orthop Trauma*; May 2020.

523. Longo, U. G., Lamberti, A., Maffulli, N., Denaro, V. Tendon augmentation grafts: a systematic review. *Br Med Bull*; 2010.

524. Malcarney, H. L., Bonar, F., Murrell, G. A. Early inflammatory reaction after rotator cuff repair with a porcine small intestine submucosal implant: a report of 4 cases. *Am J Sports Med*; Jun 2005.

525. Narayanan, Ganesh, Nair, Lakshmi S., Laurencin, Cato T. Regenerative Engineering of the Rotator Cuff of the Shoulder. *ACS Biomaterials Science & Engineering*; 2018.

526. Rodeo, S. A., Delos, D., Williams, R. J., Adler, R. S., Pearle, A., Warren, R. F. The effect of platelet-rich fibrin matrix on rotator cuff tendon healing: a prospective, randomized clinical study. *Am J Sports Med*; Jun 2012.

527. Schlegel, T. F., Abrams, J. S., Bushnell, B. D., Brock, J. L., Ho, C. P. Radiologic and clinical evaluation of a bioabsorbable collagen implant to treat partial-thickness tears: a prospective multicenter study. *J Shoulder Elbow Surg*; Feb 2018.

528. Stace, E. T., Nagra, N. S., Tiberwel, S., Khan, W., Carr, A. J. The Use of Electrospun Scaffolds in Musculoskeletal Tissue Engineering: A Focus on Tendon and the Rotator Cuff. *Curr Stem Cell Res Ther*; 2018.

529. Thangarajah, T., Pendegrass, C. J., Shahbazi, S., Lambert, S., Alexander, S., Blunn, G. W. Augmentation of Rotator Cuff Repair With Soft Tissue Scaffolds. *Orthop J Sports Med*; Jun 2015.

530. Thon, S. G., O'Malley, L.,2nd, O'Brien, M. J., Savoie, F. H.,3rd. Evaluation of Healing Rates and Safety With a Bioinductive Collagen Patch for Large and Massive Rotator Cuff Tears: 2-Year Safety and Clinical Outcomes. *Am J Sports Med*; Jul 2019.

531. Barber, F. A., Burns, J. P., Deutsch, A., Labbe, M. R., Litchfield, R. B. A prospective, randomized evaluation of acellular human dermal matrix augmentation for arthroscopic rotator cuff repair. *Arthroscopy*; Jan 2012.

532. Gupta, A. K., Hug, K., Boggess, B., Gavigan, M., Toth, A. P. Massive or 2-tendon rotator cuff tears in active patients with minimal glenohumeral arthritis: clinical and radiographic outcomes of reconstruction using dermal tissue matrix xenograft. *Am J Sports Med*; Apr 2013.

533. Hall, T., Danielson, K., Brandenburg, S., Matelic, T. A case series of recurrent myotendinous rotator cuff tears repaired and augmented with dermal allograft: clinical outcomes at two years. *J Shoulder Elbow Surg*; Nov 2020.

534. Hohn, E. A., Gillette, B. P., Burns, J. P. Outcomes of arthroscopic revision rotator cuff repair with acellular human dermal matrix allograft augmentation. *J Shoulder Elbow Surg*; May 2018.

535. Hijioka, A., Suzuki, K., Nakamura, T., Hojo, T. Degenerative change and rotator cuff tears. An anatomical study in 160 shoulders of 80 cadavers. *Arch Orthop Trauma Surg*; 1993.

536. Papalia, R., Franceschi, F., Zampogna, B., D'Adamio, S., Maffulli, N., Denaro, V. Augmentation techniques for rotator cuff repair. *Br Med Bull*; 2013.

537. Pennington, W. T., Bartz, B. A., Pauli, J. M., Walker, C. E., Schmidt, W. Arthroscopic Superior Capsular Reconstruction With Acellular Dermal Allograft for the Treatment of Massive Irreparable Rotator Cuff Tears: Short-Term Clinical Outcomes and the Radiographic Parameter of Superior Capsular Distance. *Arthroscopy*; Jun 2018.

538. Petri, M., Warth, R. J., Horan, M. P., Greenspoon, J. A., Millett, P. J. Outcomes After Open Revision Repair of Massive Rotator Cuff Tears With Biologic Patch Augmentation. *Arthroscopy*; Sep 2016.

539. Yoon, J. P., Chung, S. W., Kim, J. Y., Lee, B. J., Kim, H. S., Kim, J. E., Cho, J. H. Outcomes of Combined Bone Marrow Stimulation and Patch Augmentation for Massive Rotator Cuff Tears. *Am J Sports Med*; Apr 2016.

540. Taverna, E., Battistella, F., Sansone, V., Perfetti, C., Tasto, J. P. Radiofrequency-based plasma microtenotomy compared with arthroscopic subacromial decompression yields equivalent outcomes for rotator cuff tendinosis. *Arthroscopy*; Oct 2007.

541. Al-Ani, Zeiad, Jacobsen, Eivind Wergeland, Kartus, Jüri-Toomas, Knutsen, Gunnar, Meknas, Khaled. Radiofrequency microtenotomy: a promising method for treatment of rotator cuff tendinopathy. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2019.

542. Toliopoulos, Panagiota, Desmeules, François, Boudreault, Jennifer, Roy, Jean-Sébastien, Frémont, Pierre, MacDermid, Joy C, Dionne, Clermont E. Efficacy of surgery for rotator cuff tendinopathy: a systematic review. *Clinical Rheumatology*; 2014.

543. Lu, Yi, Zhang, Qiang, Zhu, Yiming, Jiang, Chunyan. Is radiofrequency treatment effective for shoulder impingement syndrome? A prospective randomized controlled study. *Journal of shoulder and elbow surgery*; 2013.

544. Gebremariam, Lukas, Hay, Elaine M, Koes, Bart W, Huisstede, Bionka M. Effectiveness of surgical and postsurgical interventions for the subacromial impingement syndrome: a systematic review. *Archives of physical medicine and rehabilitation*; 2011.

545. Baumann, B., Genning, K., Bohm, D., Rolf, O., Gohlke, F. Arthroscopic prevalence of pulley lesions in 1007 consecutive patients. *J Shoulder Elbow Surg*; Jan-Feb 2008.

546. Baptista, Eduardo, Malavolta, Eduardo A, Gracitelli, Mauro EC, Alvarenga, Daniel, Bordalo-Rodrigues, Marcelo, Neto, Arnaldo A Ferreira, de Barros, Nestor. Diagnostic accuracy of MRI for detection of tears and instability of proximal long head of biceps tendon: an evaluation of 100 shoulders compared with arthroscopy. *Skeletal radiology*; 2019.

547. Dubrow, Samuel A, Streit, Jonathan J, Shishani, Yousef, Robbin, Mark R, Gobezie, Reuben. Diagnostic accuracy in detecting tears in the proximal biceps tendon using standard nonenhancing shoulder MRI. *Open access journal of sports medicine*; 2014.

548. Kim, Bo Ra, Lee, Jaehyung, Ahn, Joong Mo, Kang, Yusuhn, Lee, Eugene, Lee, Joon Woo, Kang, Heung Sik. Predicting the clinically significant subscapularis tendon tear: malposition and tear of the long head of the biceps tendon on shoulder magnetic resonance imaging. *Acta Radiologica*; 2020.

549. Kim, Jung Youn, Rhee, Sung-Min, Rhee, Yong Girl. Accuracy of MRI in diagnosing intra-articular pathology of the long head of the biceps tendon: results with a large cohort of patients. *BMC musculoskeletal disorders*; 2019.

550. Lee, Ji Ho, Rhyou, In Hyeok, Ahn, Kee Baek. Prediction of the anterior shoulder pain source by detecting indirect signs for partial articular subscapularis tendon tears through conventional magnetic resonance imaging. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2020.

551. Lee, Ro Woon, Choi, Soo-Jung, Lee, Man Ho, Ahn, Jae Hong, Shin, Dong Rock, Kang, Chae Hoon, Lee, Ki Won. Diagnostic accuracy of 3T conventional shoulder MRI in the detection of the long head of the biceps tendon tears associated with rotator cuff tendon tears. *Skeletal radiology*; 2016.

552. Malavolta, E. A., Assuncao, J. H., Guglielmetti, C. L., de Souza, F. F., Gracitelli, M. E., Bordalo-Rodrigues, M., Ferreira Neto, A. A. Accuracy of preoperative MRI in the diagnosis of subscapularis tears. *Arch Orthop Trauma Surg*; Oct 2016.

553. Nascimento, Alexandre Tadeu do, Claudio, Gustavo Kogake. Magnetic resonance imaging without contrast as a diagnostic method for partial injury of the long head of the biceps tendon. *Revista brasileira de ortopedia*; 2017.

554. Schaeffeler, Christoph, Waldt, Simone, Holzapfel, Konstantin, Kirchhoff, Chlodwig, Jungmann, Pia M, Wolf, Petra, Schröder, Michael, Rummeny, Ernst J, Imhoff, Andreas B, Woertler, Klaus. Lesions of the biceps pulley: diagnostic accuracy of MR arthrography of the shoulder and evaluation of previously described and new diagnostic signs. *Radiology*; 2012.

555. Alizadeh, Ahmad, Mardani-Kivi, Mohsen, Ebrahimzadeh, Mohammad Hosein, Rouhani, Alireza, Hashemi, Keyvan, Saheb-Ekhtiari, Khashayar. A randomized prospective comparative study of four methods of biceps tendonitis treatment: Ultrasound, low-level laser+ ultrasound, intra-sheath, and extra-sheath corticosteroid guided injection. *Shiraz E Medical Journal*; 2018.

556. van Kampen, Derk A, van den Berg, Tobias, van der Woude, Henk Jan, Castelein, René M, Terwee, Caroline B, Willems, W Jaap. Diagnostic value of patient characteristics, history, and six clinical tests for traumatic anterior shoulder instability. *Journal of shoulder and elbow surgery*; 2013.

557. Holt, Tim A, Mant, David, Carr, Andrew, Gwilym, Stephen, Beard, David, Toms, Christy, Yu, Ly-Mee, Rees, Jonathan. Corticosteroid injection for shoulder pain: single-blind randomized pilot trial in primary care. *Trials*; 2013.

558. Yiannakopoulos, Christos K, Megaloikonomos, Panayiotis D, Foufa, Konstantina, Gliatis, John. Ultrasound-guided versus palpation-guided corticosteroid injections for tendinosis of the long head of the biceps: A randomized comparative study. *Skeletal radiology*; 2020.

559. Dakin, Paula, DiMartino, Stephen J, Gao, Haitao, Maloney, Jennifer, Kivitz, Alan J, Schnitzer, Thomas J, Stahl, Neil, Yancopoulos, George D, Geba, Gregory P. The Efficacy, Tolerability, and Joint Safety of Fasinumab in Osteoarthritis Pain: A Phase IIb/III Double-Blind, Placebo-Controlled, Randomized Clinical Trial. *Arthritis & Rheumatology*; 2019.

560. Schnitzer, TJ, Marks, JA. A systematic review of the efficacy and general safety of antibodies to NGF in the treatment of OA of the hip or knee. *Osteoarthritis and cartilage*; 2015.

561. Abhishek, A., Doherty, M. Diagnosis and clinical presentation of osteoarthritis. *Rheum Dis Clin North Am*; Feb 2013.

562. Anthony Ratcliffe, PhD, Evan L. Flatow, MD, Neil Roth, MD, Sued-Nejad, Fatemeh, and Louis U. Bigliani, MD. Biochemical Markers in Synovial Fluid Identify Early Osteoarthritis of the Glenohumeral Joint. *Clinical Orthopaedics and Related Research*; 1996.

563. Bijlsma, Johannes W. J., Berenbaum, Francis, Lafeber, Floris P. J. G. Osteoarthritis: an update with relevance for clinical practice. *The Lancet*; 2011.

564. Ganguly, A. Levels of C-reactive protein, creatine kinase-muscle and aldolase A are suitable biomarkers to detect the risk factors for osteoarthritic disorders: A novel diagnostic protocol. *Caspian J Intern Med*; Winter 2019.

565. Hussein, M. R., Fathi, N. A., El-Din, A. M., Hassan, H. I., Abdullah, F., Al-Hakeem, E., Backer, E. A. Alterations of the CD4(+), CD8 (+) T cell subsets, interleukins-1beta, IL-10, IL-17, tumor necrosis factor-alpha and soluble intercellular adhesion molecule-1 in rheumatoid arthritis and osteoarthritis: preliminary observations. *Pathol Oncol Res*; Sep 2008.

566. Janet Cushnaghan, Paul Dieppe. Study of 500 patients with limb joint osteoarthritis. I. Analysis by age, sex, and distribution of symptomatic joint sites. *Annals of the Rheumatic Diseases*; 1991.

567. Sinusas, Keith. Osteoarthritis: diagnosis and treatment. *American family physician*; 2012.

568. Nelson, A. E., Smith, M. W., Golightly, Y. M., Jordan, J. M. "Generalized osteoarthritis": a systematic review. *Semin Arthritis Rheum*; Jun 2014.

569. Noh, K. C., Park, S. H., Yang, C. J., Lee, G. W., Kim, M. K., Kang, Y. H. Involvement of synovial matrix degradation and angiogenesis in oxidative stress-exposed degenerative rotator cuff tears with osteoarthritis. *J Shoulder Elbow Surg*; Jan 2018.

570. Goldberg RL, et al. Elevated plasma levels of hyaluronate in patients with osteoarthritis and rheumatoid arthritis. *Arthritis and Rheumatism*; 1991.

571. Siebuhr, A. S., Bay-Jensen, A. C., Jordan, J. M., Kjelgaard-Petersen, C. F., Christiansen, C., Abramson, S. B., Attur, M., Berenbaum, F., Kraus, V., Karsdal, M. A. Inflammation (or synovitis)-driven osteoarthritis: an opportunity for personalizing prognosis and treatment? *Scand J Rheumatol*; 2016.

572. Taruc-Uy, R. L., Lynch, S. A. Diagnosis and treatment of osteoarthritis. *Prim Care*; Dec 2013.

573. Linke, Philip M, Zemke, Katrin, Ecker, Niklas Unter, Neumann, Joerg, Werner, Andreas W. Standard radiological classification of glenohumeral osteoarthritis does not correlate with the complexity of the arthritic glenoid deformity. *Archives of Orthopaedic and Trauma Surgery*; 2021.

574. Moor, BK, Bouaicha, S, Rothenfluh, DA, Sukthankar, A, Gerber, C. Is there an association between the individual anatomy of the scapula and the development of rotator cuff tears or osteoarthritis of the glenohumeral joint? A radiological study of the critical shoulder angle. *The bone & joint journal*; 2013.

575. Smith, Geoffrey CS, Liu, Victor, Lam, Patrick H. The critical shoulder angle shows a reciprocal change in magnitude when evaluating symptomatic full-thickness rotator cuff tears versus primary glenohumeral osteoarthritis as compared with control subjects: A systematic review and meta-analysis. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2020.

576. Atkinson, MH. Osteoarthrosis. *Can Fam Physician*; 1984.

577. Radiology, American,College,of. ACR Appropriateness Criteria® Shoulder Pain–Traumatic. *https://acsearch.acr.org/docs/69433/Narrative/*; 2017.

578. Radiology, American,College,of. ACR Appropriateness Criteria® Shoulder Pain–Atraumatic. *https://acsearch.acr.org/docs/3101482/Narrative/*; 2018.

579. Coscia, Atticus C, Matar, Robert N, Espinal, Emil E, Shah, Nihar S, Grawe, Brian M. Does Preoperative Diagnosis Impact Patient Outcomes Following Reverse Total Shoulder Arthroplasty? A Systematic Review. *Journal of Shoulder and Elbow Surgery*; 2020.

580. Hayes, Meredith L, Collins, Mark S, Morgan, Joseph A, Wenger, Doris E, Dahm, Diane L. Efficacy of diagnostic magnetic resonance imaging for articular cartilage lesions of the glenohumeral joint in patients with instability. *Skeletal radiology*; 2010.

581. Hurley, John A, Anderson, Thomas E. Shoulder arthroscopy: its role in evaluating shoulder disorders in the athlete. *The American journal of sports medicine*; 1990.

582. Kappe, Thomas, Elsharkawi, Mohammed, Flören, Markus, Reichel, Heiko, Cakir, Balkan. Plain radiographs have limited sensitivity for glenohumeral cartilage lesions. *Orthopedics (Online)*; 2010.

583. Lecouvet, Frédéric E, Dorzée, Benjamin, Dubuc, Jean E, Berg, Bruno C Vande, Jamart, Jacques, Malghem, Jacques. Cartilage lesions of the glenohumeral joint: diagnostic effectiveness of multidetector spiral CT arthrography and comparison with arthroscopy. *European radiology*; 2007.

584. Omoumi, Patrick, Rubini, Alexandra, Dubuc, Jean-Emile, Berg, Bruno C Vande, Lecouvet, Frédéric E. Diagnostic performance of CT-arthrography and 1.5 T MR-arthrography for the assessment of glenohumeral joint cartilage: a comparative study with arthroscopic correlation. *European radiology*; 2015.

585. Brenner, Arnold I, Koshy, June, Morey, Jose, Lin, Cheryl, DiPoce, Jason. The bone scan. *Seminars in nuclear medicine*; 2012.

586. Lee, Jeong Won, Jung, Ki Jin, Lee, Sang Mi, Chang, Sung Hae. Clinical Use of Quantitative Analysis of Bone Scintigraphy to Assess the Involvement of Arthritis Diseases in Patients with Joint Symptoms. *Diagnostics*; 2020.

587. Mazzuca, Steven A, Brandt, Kenneth D, Schauwecker, Donald S, Buckwalter, Kenneth A, Katz, Barry P, Meyer, Joan M, Lane, Kathleen A. Bone scintigraphy is not a better predictor of progression of knee osteoarthritis than Kellgren and Lawrence grade. *The Journal of rheumatology*; 2004.

588. Omoumi, Patrick, Mercier, Gustavo A, Lecouvet, Frédéric, Simoni, Paolo, Berg, Bruno C Vande. CT arthrography, MR arthrography, PET, and scintigraphy in osteoarthritis. *Radiologic Clinics*; 2009.

589. Bouaicha, Samy, Ehrmann, Christine, Slankamenac, Ksenija, Regan, William D, Moor, Beat K. Comparison of the critical shoulder angle in radiographs and computed tomography. *Skeletal radiology*; 2014.

590. Scalise, Jason J, Codsi, Michael J, Bryan, Jason, Brems, John J, Iannotti, Joseph P. The influence of three-dimensional computed tomography images of the shoulder in preoperative planning for total shoulder arthroplasty. *JBJS*; 2008.

591. Mulyadi, E., Harish, S., O'Neill, J., Rebello, R. MRI of impingement syndromes of the shoulder. *Clin Radiol*; Mar 2009.

592. Chang, E. Y., Moses, D. A., Babb, J. S., Schweitzer, M. E. Shoulder impingement: objective 3D shape analysis of acromial morphologic features. *Radiology*; May 2006.

593. Tuite, M. J., Cirillo, R. L., De Smet, A. A., Orwin, J. F. Superior labrum anterior-posterior (SLAP) tears: evaluation of three MR signs on T2-weighted images. *Radiology*; Jun 2000.

594. Connell, DA, Potter, HG, Wickiewicz, TL, Altchek, DW, Warren, RF. Noncontrast magnetic resonance imaging of superior labral lesions: 102 cases confirmed at arthroscopic surgery. *American Journal of Sports Medicine*; Mar-Apr 1999.

595. McFarland, E. G., Tanaka, M. J., Garzon-Muvdi, J., Jia, X., Petersen, S. A. Clinical and imaging assessment for superior labrum anterior and posterior lesions. *Current Sports Medicine Reports*; Sep-Oct 2009.

596. Cartland, J. P., Crues, J. V.,3rd, Stauffer, A., Nottage, W., Ryu, R. K. MR imaging in the evaluation of SLAP injuries of the shoulder: findings in 10 patients. *AJR American Journal Of Roentgenology*; Oct 1992.

597. Chang, D., Mohana-Borges, A., Borso, M., Chung, C. B. SLAP lesions: anatomy, clinical presentation, MR imaging diagnosis and characterization. *Eur J Radiol*; Oct 2008.

598. Tirman, P. F., Bost, F. W., Steinbach, L. S., Mall, J. C., Peterfy, C. G., Sampson, T. G., Sheehan, W. E., Forbes, J. R., Genant, H. K. MR arthrographic depiction of tears of the rotator cuff: benefit of abduction and external rotation of the arm. *Radiology*; Sep 1994.

599. Wnorowski, D. C., Levinsohn, E. M., Chamberlain, B. C., McAndrew, D. L. Magnetic resonance imaging assessment of the rotator cuff: is it really accurate? *Arthroscopy*; Dec 1997.

600. Tung, G. A., Entzian, D., Green, A., Brody, J. M. High-field and low-field MR imaging of superior glenoid labral tears and associated tendon injuries. *AJR Am J Roentgenol*; Apr 2000.

601. Reuss, B. L., Schwartzberg, R., Zlatkin, M. B., Cooperman, A., Dixon, . Magnetic resonance imaging accuracy for the diagnosis of superior labrum anterior-posterior lesions in the community setting: eighty-three arthroscopically confirmed cases. *Journal Of Shoulder And Elbow Surgery*; Sep-Oct 2006.

602. Lee, Shi-Uk, Lang, Philipp. MR and MR arthrography to identify degenerative and posttraumatic diseases in the shoulder joint. *European journal of radiology*; 2000.

603. Stein, Beth E Shubin, Wiater, J Michael, Pfaff, H Charles, Bigliani, Louis U, Levine, William N. Detection of acromioclavicular joint pathology in asymptomatic shoulders with magnetic resonance imaging. *Journal of shoulder and elbow surgery*; 2001.

604. Bradley, Michael P, Tung, Glenn, Green, Andrew. Overutilization of shoulder magnetic resonance imaging as a diagnostic screening tool in patients with chronic shoulder pain. *Journal of shoulder and elbow surgery*; 2005.

605. Guermazi, Ali, Hunter, David J, Roemer, Frank W. Plain radiography and magnetic resonance imaging diagnostics in osteoarthritis: validated staging and scoring. *JBJS*; 2009.

606. Choo, Hye Jung, Lee, Sun Joo, Kim, Jung Han, Cha, Seong Sook, Park, Young Mi, Park, Ji Sung, Lee, Jun Woo, Oh, Minkyung. Can symptomatic acromioclavicular joints be differentiated from asymptomatic acromioclavicular joints on 3-T MR imaging? *European journal of radiology*; 2013.

607. Raymond, Antony C, McCann, Philip A, Sarangi, Partha P. Magnetic resonance scanning vs axillary radiography in the assessment of glenoid version for osteoarthritis. *Journal of shoulder and elbow surgery*; 2013.

608. Spiegl, Ulrich J, Horan, Marilee P, Smith, Sean W, Ho, Charles P, Millett, Peter J. The critical shoulder angle is associated with rotator cuff tears and shoulder osteoarthritis and is better assessed with radiographs over MRI. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2016.

609. Lowe, Jeremiah T, Testa, Edward J, Li, Xinning, Miller, Suzanne, DeAngelis, Joseph P, Jawa, Andrew. Magnetic resonance imaging is comparable to computed tomography for determination of glenoid version but does not accurately distinguish between Walch B2 and C classifications. *Journal of shoulder and elbow surgery*; 2017.

610. Singh, Bijayendra, Gulihar, Abhinav, Bilagi, Praveen, Goyal, Arpit, Goyal, Pallavi, Bawale, Rajesh, Pillai, Dilip. Magnetic resonance imaging scans are not a reliable tool for predicting symptomatic acromioclavicular arthritis. *Shoulder & elbow*; 2018.

611. Veen, Egbert JD, Donders, Cornelia M, Westerbeek, Robin E, Derks, Rosalie PH, Landman, Ellie BM, Koorevaar, Cornelis T. Predictive findings on magnetic resonance imaging in patients with symptomatic acromioclavicular osteoarthritis. *Journal of shoulder and elbow surgery*; 2018.

612. Abdelzaher, Mohamed Gamal, Tharwat, Samar, AbdElkhalek, Ahmed, Abdelsalam, Adel. Ultrasound versus magnetic resonance imaging in the evaluation of shoulder joint pathologies in a cohort of rheumatoid arthritis patients. *International journal of rheumatic diseases*; 2019.

613. Jungmann, Pia M, Gersing, Alexandra S, Woertler, Klaus, Dietrich, Tobias J, Baum, Thomas, Baumann, Frederic, Bensler, Susanne. Reliable semiquantitative whole-joint MRI score for the shoulder joint: The shoulder osteoarthritis severity (SOAS) score. *Journal of Magnetic Resonance Imaging*; 2019.

614. Wuennemann, Felix, Kintzelé, Laurent, Braun, Alexander, Zeifang, Felix, Maier, Michael W, Burkholder, Iris, Weber, Marc-André, Kauczor, Hans-Ulrich, Rehnitz, Christoph. 3-T T2 mapping magnetic resonance imaging for biochemical assessment of normal and damaged glenoid cartilage: a prospective arthroscopy-controlled study. *Scientific Reports*; 2020.

615. Badet, R, Boileau, P, Noel, E, Walch, G. Arthrography and computed arthrotomography study of seventy patients with primary glenohumeral osteoarthritis. *Revue du rhumatisme (English ed.)*; 1995.

616. Catalano, Onofrio A, Manfredi, Riccardo, Vanzulli, Angelo, Tomei, Ernesto, Napolitano, Marcelo, Esposito, Andrea, Resnick, Donald. MR arthrography of the glenohumeral joint: modified posterior approach without imaging guidance. *Radiology*; 2007.

617. Vahlensieck, Martin, Peterfy, Charles G, Wischer, Thorsten, Sommer, Thorsten, Lang, Philipp, Schlippert, Ulrich, Genant, Harry K, Schild, Hans H. Indirect MR arthrography: optimization and clinical applications. *Radiology*; 1996.

618. Guntern, Daniel V, Pfirrmann, Christian WA, Schmid, Marius R, Zanetti, Marco, Binkert, Christoph A, Schneeberger, Alberto G, Hodler, Juerg. Articular cartilage lesions of the glenohumeral joint: diagnostic effectiveness of MR arthrography and prevalence in patients with subacromial impingement syndrome. *Radiology*; 2003.

619. Saqib, R, Harris, J, Funk, L. Comparison of magnetic resonance arthrography with arthroscopy for imaging of shoulder injuries: retrospective study. *The Annals of The Royal College of Surgeons of England*; 2017.

620. Iagnocco, Annamaria. Imaging the joint in osteoarthritis: a place for ultrasound? *Best Practice & Research Clinical Rheumatology*; 2010.

621. Hanly, JG,Barnes,DC,Mitchell,MJ,et al. Single photon emission computed tomography in the diagnosis of inflammatory spondyloarthropathie. *J Rheumatol*; 1993.

622. Nguyen, Brian J, Burt, Ashley, Baldassare, Randall L, Smitaman, Edward, Morshedi, Maud, Kao, Steven, Chang, Eric Y, Obrzut, Sebastian. The prognostic and diagnostic value of FDG PET/CT for assessment of symptomatic osteoarthritis. *Nuclear medicine communications*; 2018.

623. Wandler, Eric, Kramer, Elissa L, Sherman, Orrin, Babb, James, Scarola, Jean, Rafii, Mahvash. Diffuse FDG shoulder uptake on PET is associated with clinical findings of osteoarthritis. *American Journal of Roentgenology*; 2005.

624. David H. Sikesa, Naurang M. Agrawalb,William W. Zhaoc,Jeffrey D. Kentc, Verburgc, David,P.,Reckerc,and,Kenneth,M. Gastrointestinal Toxicity with Celecoxib vs Nonsteroidal Anti-inflammatory Drugs for Osteoarthritis and Rheumatoid Arthritis. *JAMA*; 2000.

625. David H. Sikesa, Naurang M. Agrawalb,William W. Zhaoc,Jeffrey D. Kentc, Verburgc, David,P.,Reckerc,and,Kenneth,M. Incidence of gastroduodenal ulcers associated with valdecoxib compared with that of ibuprofen and diclofenac in patients with osteoarthritis. 2002.

626. Derry, S., Wiffen, P. J., Kalso, E. A., Bell, R. F., Aldington, D., Phillips, T., Gaskell, H., Moore, R. A. Topical analgesics for acute and chronic pain in adults - an overview of Cochrane Reviews. *Cochrane Database Syst Rev*; May 12 2017.

627. Gotzche, Peter,C. Non-steroidal anti-inflammatory drugs. *BMJ*; 2000.

628. Jadhav, M. P., Jadhav, P. M., Mutke, A. P., Sonawane, S. D., Patil, B. D., Naik, N. B., Sonawale, A. S. A prospective observational study to assess quality of life and prescription pattern in osteoarthritis patients at tertiary health centre in Mumbai. *Indian J Med Sci*; Feb 2011.

629. James F. Fries, Bonnie Bruce. Rates of Serious Gastrointestinal Events from Low Dose Use of Acetylsalicylic Acid, Acetaminophen, and Ibuprofen in Patients with Osteoarthritis and Rheumatoid Arthritis. *The Journal of Rhematology*; 2003.

630. Jordan, Robert W., Kelly, Cormac P. Management of glenohumeral arthritis in the young patient – A systematic review. *Journal of Arthroscopy and Joint Surgery*; 2019.

631. Massey, T., Derry, S., Moore, R. A., McQuay, H. J. Topical NSAIDs for acute pain in adults. *Cochrane Database Syst Rev*; Jun 16 2010.

632. MCCleane, Gary. The addition of piroxicam to topically applied glyceryl trinitrate enhances its analgesic effect in musculoskeletal pain: a randomised, double-blind, placebo-controlled study. *The Pain Clinic*; 2000.

633. Moore, R. A., Wiffen, P. J., Derry, S., Maguire, T., Roy, Y. M., Tyrrell, L. Non-prescription (OTC) oral analgesics for acute pain - an overview of Cochrane reviews. *Cochrane Database Syst Rev*; Nov 4 2015.

634. Millett, P. J., Gobezie, R, Boykin, R.E. Shoulder Osteoarthritis: Diagnosis and Management. 2008.

635. Raffaeli, W., Pari, C., Corvetta, A., Sarti, D., Di Sabatino, V., Biasi, G., Galeazzi, M. Oxycodone/acetaminophen at low dosage: an alternative pain treatment for patients with rheumatoid arthritis. *J Opioid Manag*; Jan-Feb 2010.

636. Richy, F., Scarpignato, C., Lanas, A., Reginster, J. Y. Efficacy and safety of piroxicam revisited. A global meta-analysis of randomised clinical trials. *Pharmacol Res*; Oct 2009.

637. Roland W. Moskowitz, Theodore A. Blaine. An Overview of Treatment Options for Persistent Shoulder Pain. *A Supplement to the American Journal of Orthopedics*; 2005.

638. Sardana, V., Burzynski, J., Hasan, K., Zalzal, P. Are non-steroidal anti-inflammatory drug injections an alternative to steroid injections for musculoskeletal pain?: A systematic review. *J Orthop*; Sep 2018.

639. Taylor, R. S., Fotopoulos, G., Maibach, H. Safety profile of topical diclofenac: a meta-analysis of blinded, randomized, controlled trials in musculoskeletal conditions. *Curr Med Res Opin*; Mar 2011.

640. Towheed, T. E., Maxwell, L., Judd, M. G., Catton, M., Hochberg, M. C., Wells, G. Acetaminophen for osteoarthritis. *Cochrane Database Syst Rev*; Jan 25 2006.

641. van der Windt, D. A., van der Heijden, G. J., Scholten, R. J., Koes, B. W., Bouter, L. M. The efficacy of non-steroidal anti-inflammatory drugs (NSAIDS) for shoulder complaints. A systematic review. *J Clin Epidemiol*; May 1995.

642. Chen, Y-F, Jobanputra, P, Barton, P, S, Bryan, Fry-Smith, A, Harris, G, Taylor, RS. Cyclooxygenase-2 selective non-steroidal anti-inflammatory drugs (etodolac, meloxicam, celecoxib,rofecoxib, etoricoxib, valdecoxib and lumiracoxib) for osteoarthritis and rheumatoid arthritis: a systematic review and economic evaluation. 2008.

643. Yelland, M. J., Nikles, C. J., McNairn, N., Del Mar, C. B., Schluter, P. J., Brown, R. M. Celecoxib compared with sustained-release paracetamol for osteoarthritis: a series of n-of-1 trials. *Rheumatology (Oxford)*; Jan 2007.

644. Zacher, J., Altman, R., Bellamy, N., Bruhlmann, P., Da Silva, J., Huskisson, E., Taylor, R. S. Topical diclofenac and its role in pain and inflammation: an evidence-based review. *Curr Med Res Opin*; Apr 2008.

645. Diamond, H. S. Double-blind crossover study of fenoprofen and aspirin in osteoarthritis. *J Rheumatol*; 1976.

646. Bellamy, N., Bensen, W. G., Beaulieu, A., Siminovitch, K. A., Kraag, G. R., Lussier, A., Ahmad, S., Khanna, V. N., Davis, P., Bell, M. J., et al., . A multicenter study of nabumetone and diclofenac SR in patients with osteoarthritis. *J Rheumatol*; May 1995.

647. Bullock, Garrett S, Garrigues, Grant E, Ledbetter, Leila, Kennedy, June. A systematic review of proposed rehabilitation guidelines following anatomic and reverse shoulder arthroplasty. *journal of orthopaedic & sports physical therapy*; 2019.

648. Moore, M. E., Berk, S. N. Acupuncture for chronic shoulder pain. An experimental study with attention to the role of placebo and hypnotic susceptibility. *Ann Intern Med*; Apr 1976.

649. Vickers, Andrew J, Cronin, Angel M, Maschino, Alexandra C, Lewith, George, MacPherson, Hugh, Foster, Nadine E, Sherman, Karen J, Witt, Claudia M, Linde, Klaus, Acupuncture Trialists' Collaboration, for the. Acupuncture for chronic pain: individual patient data meta-analysis. *Archives of internal medicine*; 2012.

650. Brantingham, James W, Parkin-Smith, Gregory, Cassa, Tammy Kay, Globe, Gary A, Globe, Denise, Pollard, Henry, deLuca, Katie, Jensen, Muffit, Mayer, Stephan, Korporaal, Charmaine. Full kinetic chain manual and manipulative therapy plus exercise compared with targeted manual and manipulative therapy plus exercise for symptomatic osteoarthritis of the hip: a randomized controlled trial. *Archives of physical medicine and rehabilitation*; 2012.

651. Minkalis, Amy L, Vining, Robert D, Long, Cynthia R, Hawk, Cheryl, de Luca, Katie. A systematic review of thrust manipulation for non-surgical shoulder conditions. *Chiropractic & manual therapies*; 2017.

652. Altınbilek, Turgay, Murat, Sadiye, Yumuşakhuylu, Yasemin, İçağasıoğlu, Afitap. Osteopathic manipulative treatment improves function and relieves pain in knee osteoarthritis: A single-blind, randomized-controlled trial. *Turkish journal of physical medicine and rehabilitation*; 2018.

653. Brantingham, James W, Cassa, Tammy Kay, Bonnefin, Debra, Jensen, Muffit, Globe, Gary, Hicks, Marian, Korporaal, Charmaine. Manipulative therapy for shoulder pain and disorders: expansion of a systematic review. *Journal of manipulative and physiological therapeutics*; 2011.

654. Brosseau, Lucie, Wells, George A, Pugh, Arlanna G, Smith, Christine AM, Rahman, Prinon, Àlvarez Gallardo, Inmaculada C, Toupin-April, Karine, Loew, Laurianne, De Angelis, Gino, Cavallo, Sabrina. Ottawa Panel evidence-based clinical practice guidelines for therapeutic exercise in the management of hip osteoarthritis. *Clinical rehabilitation*; 2016.

655. Lin, Ivan, Wiles, Louise, Waller, Rob, Goucke, Roger, Nagree, Yusuf, Gibberd, Michael, Straker, Leon, Maher, Chris G, O'Sullivan, Peter PB. What does best practice care for musculoskeletal pain look like? Eleven consistent recommendations from high-quality clinical practice guidelines: systematic review. *British journal of sports medicine*; 2020.

656. Brosseau, Lucie, Yonge, KA, Welch, Vivian, Marchand, S, Judd, Maria, Wells, George A, Tugwell, Peter. Thermotherapy for treatment of osteoarthritis. *Cochrane Database of Systematic Reviews*; 2003.

657. Collins, Natalie J, Hart, Harvi F, Mills, Kathryn AG. Osteoarthritis year in review 2018: rehabilitation and outcomes. *Osteoarthritis and Cartilage*; 2019.

658. Sefton, JoEllen M, Yarar, Ceren, Carpenter, David M, Berry, Jack W. Physiological and clinical changes after therapeutic massage of the neck and shoulders. *Manual Therapy*; 2011.

659. Patterson, Abbey, Dickerson, Clark R, Ribeiro, Daniel C. The Effect of Shoulder Mobilization on Scapular and Shoulder Muscle Activity During Resisted Shoulder Abduction: A Crossover Study of Asymptomatic Individuals. *Journal of Manipulative and Physiological Therapeutics*; 2020.

660. Adegoke, BOA, Gbeminiyi, MO. Efficacy of ice and shortwave diathermy in the management of osteoarthritis on the knee-A preliminary. *African Journal of Biomedical Research*; 2004.

661. Rabini, A., Piazzini, D. B., Bertolini, C., Deriu, L., Saccomanno, M. F., Santagada, D. A., Sgadari, A., Bernabei, R., Fabbriciani, C., Marzetti, E., Milano, G. Effects of local microwave diathermy on shoulder pain and function in patients with rotator cuff tendinopathy in comparison to subacromial corticosteroid injections: a single-blind randomized trial. *J Orthop Sports Phys Ther*; Apr 2012.

662. Boyaci, Ahmet, Tutoglu, Ahmet, Boyaci, Nurefsan, Aridici, Rifat, Koca, Irfan. Comparison of the efficacy of ketoprofen phonophoresis, ultrasound, and short-wave diathermy in knee osteoarthritis. *Rheumatology international*; 2013.

663. Kim, Gook-Joo, Choi, Jioun, Lee, Sangyong, Jeon, Chunbae, Lee, Kwansub. The effects of high intensity laser therapy on pain and function in patients with knee osteoarthritis. *Journal of physical therapy science*; 2016.

664. White, Paul F, Lazo, Ofelia Loani Elvir, Galeas, Lidia, Cao, Xuezhao. Use of electroanalgesia and laser therapies as alternatives to opioids for acute and chronic pain management. *F1000Research*; 2017.

665. Papadopoulos, Emmanuel S, Mani, Raj. The role of ultrasound therapy in the management of musculoskeletal soft tissue pain. *The International Journal of Lower Extremity Wounds*; 2020.

666. Valdes, Kristin, Marik, Tambra. A systematic review of conservative interventions for osteoarthritis of the hand. *Journal of Hand Therapy*; 2010.

667. Huang, Z, Chen, J, Ma, J, Shen, B, Pei, F, Kraus, VB. Effectiveness of low-level laser therapy in patients with knee osteoarthritis: a systematic review and meta-analysis. *Osteoarthritis and cartilage*; 2015.

668. Mazzola, Anthony, Spinner, David. Ultrasound-Guided Peripheral Nerve Stimulation for Shoulder Pain: Anatomic Review and Assessment of the Current Clinical Evidence. *Pain Physician*; 2020.

669. O'Leary, Helen, Smart, Keith M, Moloney, Niamh A, Doody, Catherine M. Nervous system sensitization as a predictor of outcome in the treatment of peripheral musculoskeletal conditions: a systematic review. *Pain practice*; 2017.

670. Beaudreuil, J., Nizard, R., Thomas, T., Peyre, M., Liotard, J. P., Boileau, P., Marc, T., Dromard, C., Steyer, E., Bardin, T., Orcel, P., Walch, G. Contribution of clinical tests to the diagnosis of rotator cuff disease: a systematic literature review. *Joint Bone Spine*; Jan 2009.

671. Nguyen, Jean-Paul, Dixneuf, Véronique, Esnaut, Julien, Moreno, Alcira Suarez, Malineau, Catherine, Nizard, Julien, Lefaucheur, Jean-Pascal. The value of high-frequency repetitive transcranial magnetic stimulation of the motor cortex to treat central pain sensitization associated with knee osteoarthritis. *Frontiers in neuroscience*; 2019.

672. Paolucci, Teresa, Pezzi, Letizia, Centra, Antonello Marco, Giannandrea, Niki, Bellomo, Rosa Grazia, Saggini, Raoul. Electromagnetic Field Therapy: A Rehabilitative Perspective in the Management of Musculoskeletal Pain–A Systematic Review. *Journal of Pain Research*; 2020.

673. Park, Ki Deok, Kim, Tai Kon, Lee, Jihae, Lee, Woo Yong, Ahn, Jae Ki, Park, Yongbum. Palpation Versus Ultrasound-Guided Acromioclavicular Joint Intra-articular Corticosteroid Injections: A Retrospective Comparative Clinical Study. *Pain Physician*; 2015.

674. Ayub, Shazeen, Kaur, Jaspreet, Hui, Michelle, Espahbodi, Shima, Hall, Michelle, Doherty, Michael, Zhang, Weiya. Efficacy and safety of multiple intra-articular corticosteroid injections for osteoarthritis—a systematic review and meta-analysis of randomized controlled trials and observational studies. *Rheumatology*; 2021.

675. Caglar-Yagci H, Unsal S,Yagci I,Dulgeroglu D,Ozel S. Safety and efficacy of ultrasound-guided intra-articular hylan G-F 20 injection in osteoarthritis of the hip: a pilot study. *Rheumatol Int*; 2005.

676. Tikiz, C., Unlu, Z., Sener, A., Efe, M., Tuzun, C. Comparison of the efficacy of lower and higher molecular weight viscosupplementation in the treatment of hip osteoarthritis. *Clin Rheumatol*; Jun 2005.

677. Abate, M., Di Carlo, L., Salini, V., Schiavone, C. Risk factors associated to bilateral rotator cuff tears. *Orthop Traumatol Surg Res*; Oct 2017.

678. van den Bekerom, M. P., Lamme, B., Sermon, A., Mulier, M. What is the evidence for viscosupplementation in the treatment of patients with hip osteoarthritis? Systematic review of the literature. *Arch Orthop Trauma Surg*; Aug 2008.

679. Dagenais, S. Intra-articular hyaluronic acid (viscosupplementation) for hip osteoarthritis. *Issues Emerg Health Technol*; May 2007.

680. Blaine, T., Moskowitz, R., Udell, J., Skyhar, M., Levin, R., Friedlander, J., Daley, M., Altman, R. Treatment of persistent shoulder pain with sodium hyaluronate: a randomized, controlled trial. A multicenter study. *J Bone Joint Surg Am*; May 2008.

681. Kwon, Y. W., Eisenberg, G., Zuckerman, J. D. Sodium hyaluronate for the treatment of chronic shoulder pain associated with glenohumeral osteoarthritis: a multicenter, randomized, double-blind, placebo-controlled trial. *J Shoulder Elbow Surg*; May 2013.

682. Colen S, Geervliet P,Haverkamp D,Van Den Bekerom MP. Intra-articular infiltration therapy for patients with glenohumeral osteoarthritis: A systematic review of the literature. *J Shoulder Surg*; 2014.

683. Colen, Sascha, Haverkamp, Daniel, Mulier, Michiel, Van Den Bekerom, Michel PJ. Hyaluronic Acid for the Treatment of Osteoarthritis in all Joints Except the Knee. *BioDrugs*; 2012.

684. De Lucia, Orazio, Murgo, Antonella, Pregnolato, Francesca, Pontikaki, Irene, De Souza, Mirian, Sinelli, Alessandro, Cimaz, Rolando, Caporali, Roberto. Hyaluronic Acid Injections in the Treatment of Osteoarthritis Secondary to Primary Inflammatory Rheumatic Diseases: A Systematic Review and Qualitative Synthesis. *Advances in therapy*; 2020.

685. Di Giacomo, G, de Gasperis, N. Hyaluronic acid intra-articular injections in patients affected by moderate to severe glenohumeral osteoarthritis: a prospective randomized study. *Joints*; 2017.

686. Reid, M Carrington. Viscosupplementation for osteoarthritis: a primer for primary care physicians. *Advances in therapy*; 2013.

687. Tran, Khai, Loshak, Hannah. Intra-articular hyaluronic acid for viscosupplementation in osteoarthritis of the hand, shoulder, and temporomandibular joint: a review of clinical effectiveness and safety. 2019.

688. Godek, P., Szajkowski, S., Golicki, D. Evaluation of the Effectiveness of Orthokine Therapy: Retrospective Analysis of 1000 Cases. *Ortop Traumatol Rehabil*; Apr 30 2020.

689. Simon, M. J. K., Aartsen, V. E., Coghlan, J. A., Strahl, A., Bell, S. N. Shoulder injections with autologous conditioned serum reduce pain and disability in glenohumeral osteoarthritis: longitudinal observational study. *ANZ J Surg*; Feb 20 2021.

690. Robinson, David M, Eng, Christine, Makovitch, Steven, Rothenberg, Joshua B, DeLuca, Stephanie, Douglas, Stephanie, Civitarese, David, Borg-Stein, Joanne. Non-operative orthobiologic use for rotator cuff disorders and glenohumeral osteoarthritis: A systematic review. *Journal of Back and Musculoskeletal Rehabilitation*; 2020.

691. Bishop, J. Y., Flatow, E. L. Management of glenohumeral arthritis: a role for arthroscopy? *Orthop Clin North Am*; Oct 2003.

692. Guyette, T. M., Bae, H., Warren, R. F., Craig, E., Wickiewicz, T. L. Results of arthroscopic subacromial decompression in patients with subacromial impingement and glenohumeral degenerative joint disease. *J Shoulder Elbow Surg*; Jul-Aug 2002.

693. Sperling, J. W., Steinmann, S. P., Cordasco, F. A., Henshaw, D. R., Coons, D. A., Burkhead, W. Z. Shoulder arthritis in the young adult: arthroscopy to arthroplasty. *Instr Course Lect*; 2006.

694. Arner, Justin W, Elrick, Bryant P, Nolte, Philip-C, Haber, Daniel B, Horan, Marilee P, Millett, Peter J. Survivorship and Patient-Reported Outcomes After Comprehensive Arthroscopic Management of Glenohumeral Osteoarthritis: Minimum 10-Year Follow-up. *The American Journal of Sports Medicine*; 2021.

695. Hartzler, Robert U, Melapi, Sabelo, de Beer, Joe F, Burkhart, Stephen S. Arthroscopic joint preservation in severe glenohumeral arthritis using interpositional human dermal allograft. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2017.

696. Millett, P. J., Horan, M. P., Pennock, A. T., Rios, D. Comprehensive Arthroscopic Management (CAM) procedure: clinical results of a joint-preserving arthroscopic treatment for young, active patients with advanced shoulder osteoarthritis. *Arthroscopy*; Mar 2013.

697. Mitchell, Justin J, Warner, Brent T, Horan, Marilee P, Raynor, M Brett, Menge, Travis J, Greenspoon, Joshua A, Millett, Peter J. Comprehensive arthroscopic management of glenohumeral osteoarthritis: preoperative factors predictive of treatment failure. *The American journal of sports medicine*; 2017.

698. Porcellini, Giuseppe, Merolla, Giovanni, Campi, Fabrizio, Pellegrini, Andrea, Bodanki, Chandra Sekhar, Paladini, Paolo. Arthroscopic treatment of early glenohumeral arthritis. *Journal of Orthopaedics and Traumatology*; 2013.

699. Skelley, Nathan W, Namdari, Surena, Chamberlain, Aaron M, Keener, Jay D, Galatz, Leesa M, Yamaguchi, Ken. Arthroscopic debridement and capsular release for the treatment of shoulder osteoarthritis. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2015.

700. Van Thiel, Geoffrey S, Sheehan, Steven, Frank, Rachel M, Slabaugh, Mark, Cole, Brian J, Nicholson, Gregory P, Romeo, Anthony A, Verma, Nikhil N. Retrospective analysis of arthroscopic management of glenohumeral degenerative disease. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2010.

701. Weinstein, David M, Bucchieri, John S, Pollock, Roger G, Flatow, Evan L, Bigliani, Louis U. Arthroscopic debridement of the shoulder for osteoarthritis. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2000.

702. Williams, Brady T, Beletsky, Alexander, Kunze, Kyle N, Polce, Evan M, Cole, Brian J, Verma, Nikhil N, Chahla, Jorge. Outcomes and survivorship after arthroscopic treatment of glenohumeral arthritis: a systematic review. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2020.

703. Wolf, Megan R, Williams, Ariel A, Friedman, Jamie L, Shea, Kevin P. Arthroscopic capsular release and debridement of painful shoulder osteoarthritis can improve symptoms and delay arthroplasty: a mid-to long-term follow-up study. *Seminars in Arthroplasty: JSES*; 2021.

704. Moseley, J. B., O'Malley, K., Petersen, N. J., Menke, T. J., Brody, B. A., Kuykendall, D. H., Hollingsworth, J. C., Ashton, C. M., Wray, N. P. A controlled trial of arthroscopic surgery for osteoarthritis of the knee. *N Engl J Med*; Jul 11 2002.

705. Mitchell, J. J., Horan, M. P., Greenspoon, J. A., Menge, T. J., Tahal, D. S., Millett, P. J. Survivorship and Patient-Reported Outcomes After Comprehensive Arthroscopic Management of Glenohumeral Osteoarthritis: Minimum 5-Year Follow-up. *Am J Sports Med*; Dec 2016.

706. Solomon, D. J., Navaie, M., Stedje-Larsen, E. T., Smith, J. C., Provencher, M. T. Glenohumeral chondrolysis after arthroscopy: a systematic review of potential contributors and causal pathways. *Arthroscopy*; Nov 2009.

707. Freedman, B. A., Javernick, M. A., O'Brien, F. P., Ross, A. E., Doukas, W. C. Arthroscopic versus open distal clavicle excision: comparative results at six months and one year from a randomized, prospective clinical trial. *J Shoulder Elbow Surg*; Jul-Aug 2007.

708. Berg, E. E., Ciullo, J. V. The SLAP lesion: a cause of failure after distal clavicle resection. *Arthroscopy*; Feb 1997.

709. Bigliani, L. U., Nicholson, G. P., Flatow, E. L. Arthroscopic resection of the distal clavicle. *Orthop Clin North Am*; Jan 1993.

710. Cook, F. F., Tibone, J. E. The Mumford procedure in athletes. An objective analysis of function. *Am J Sports Med*; Mar-Apr 1988.

711. Corso, S. J., Furie, E. Arthroscopy of the acromioclavicular joint. *Orthop Clin North Am*; Oct 1995.

712. Flatow, E. L., Duralde, X. A., Nicholson, G. P., Pollock, R. G., Bigliani, L. U. Arthroscopic resection of the distal clavicle with a superior approach. *J Shoulder Elbow Surg*; Jan-Feb 1995.

713. Gartsman, GM. Arthroscopic resection of the acromioclavicular joint. *Am J Sports Med*; 1993.

714. Lesko, P. D. Variation of the arthroscopic Mumford procedure for resecting the distal clavicle. *J South Orthop Assoc*; Winter 2001.

715. Levine, W. N., Barron, O. A., Yamaguchi, K., Pollock, R. G., Flatow, E. L., Bigliani, L. U. Arthroscopic distal clavicle resection from a bursal approach. *Arthroscopy*; Jan-Feb 1998.

716. Petersson, C. J. Degeneration of the acromioclavicular joint. A morphological study. *Acta Orthop Scand*; Jun 1983.

717. Gurd, F. B. The treatment of complete dislocation of the outer end of the clavicle: an hitherto undescribed operation. *Ann Surg*; Jun 1941.

718. Mumford, EB. Acromioclavicular dislocation: a new operative treatment. *The Journal of Bone and Joint Surgery*; 1941.

719. Charron, K. M., Schepsis, A. A., Voloshin, I. Arthroscopic distal clavicle resection in athletes: a prospective comparison of the direct and indirect approach. *Am J Sports Med*; Jan 2007.

720. Flatow, E. L., Cordasco, F. A., Bigliani, L. U. Arthroscopic resection of the outer end of the clavicle from a superior approach: a critical, quantitative, radiographic assessment of bone removal. *Arthroscopy*; 1992.

721. Chalmers, Peter N, Granger, Erin, Ross, Hunter, Burks, Robert T, Tashjian, Robert Z. Preoperative factors associated with subsequent distal clavicle resection after rotator cuff repair. *Orthopaedic journal of sports medicine*; 2019.

722. Gokkus, K, Saylik, M, Atmaca, H, Sagtas, E, Aydin, AT. Limited distal clavicle excision of acromioclavicular joint osteoarthritis. *Orthopaedics & Traumatology: Surgery & Research*; 2016.

723. Kim, Jaehwa, Chung, Juhwan, Ok, Hyunsoo. Asymptomatic acromioclavicular joint arthritis in arthroscopic rotator cuff tendon repair: a prospective randomized comparison study. *Archives of orthopaedic and trauma surgery*; 2011.

724. Rabalais, R David, McCarty, Eric. Surgical treatment of symptomatic acromioclavicular joint problems: a systematic review. *Clinical Orthopaedics and Related Research (1976-2007)*; 2007.

725. Razmjou, Helen, ElMaraghy, Amr, Dwyer, Tim, Fournier-Gosselin, Simon, Devereaux, Moira, Holtby, Richard. Outcome of distal clavicle resection in patients with acromioclavicular joint osteoarthritis and full-thickness rotator cuff tear. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2015.

726. Harreld, K. L., Marulanda, G. A., Ulrich, S. D., Marker, D. R., Seyler, T. M., Mont, M. A. Small-diameter percutaneous decompression for osteonecrosis of the shoulder. *Am J Orthop (Belle Mead NJ)*; Jul 2009.

727. Ficat, RP. Idiopathic bone necrosis of the femoral head. Early diagnosis and treatment. *J Bone Joint Surg Br*; 1985.

728. Jacobs, B. Epidemiology of traumatic and nontraumatic osteonecrosis. *Clin Orthop Relat Res*; Jan-Feb 1978.

729. Harreld, K. L., Marker, D. R., Wiesler, E. R., Shafiq, B., Mont, M. A. Osteonecrosis of the humeral head. *J Am Acad Orthop Surg*; Jun 2009.

730. Zizic, TM, Marcoux, C, Hungerford, DS, Stevens, MB. The early diagnosis of ischemic necrosis of bone. *Arthritis & Rheumatism: Official Journal of the American College of Rheumatology*; 1986.

731. L'Insalata, John C, Pagnani, Michael J, Warren, Russell F, Dines, David M. Humeral head osteonecrosis: clinical course and radiographic predictors of outcome. *Journal of shoulder and elbow surgery*; 1996.

732. Shinoda, S, Hasegawa, Y, Kawasaki, S, Tagawa, N, Iwata, H. Magnetic resonance imaging of osteonecrosis in divers: comparison with plain radiographs. *Skeletal radiology*; 1997.

733. Blanchard, T. K., Bearcroft, P. W., Constant, C. R., Griffin, D. R., Dixon, A. K. Diagnostic and therapeutic impact of MRI and arthrography in the investigation of full-thickness rotator cuff tears. *Eur Radiol*; 1999.

734. Carette, S. Adhesive capsulitis--research advances frozen in time? *J Rheumatol*; Jun 2000.

735. Lee, Michael, Theodoulou, Annika, Krishnan, Jeganath. Criteria used for diagnosis of adhesive capsulitis of the shoulder: a scoping review protocol. *JBI Evidence Synthesis*; 2018.

736. Zuckerman, Joseph D, Rokito, Andrew. Frozen shoulder: a consensus definition. *Journal of Shoulder and Elbow Surgery*; 2011.

737. Cerny, Milena, Omoumi, Patrick, Larbi, Ahmed, Manicourt, Daniel, Perozziello, Anne, Lecouvet, Frédéric, Berg, Bruno Vande, Dallaudiere, Benjamin. CT arthrography of adhesive capsulitis of the shoulder: Are MR signs applicable? *European journal of radiology open*; 2017.

738. Polat, Gökhan, Ogul, Hayri, Yalçin, Ahmet, Tuncer, Kutsi, Kaya, Serhat, Pirimoglu, Berhan, Sade, Recep, Kantarci, Mecit. Efficacy of the Rotational Traction Method in the Assessment of Glenohumeral Cartilage Surface Area in Computed Tomography Arthrography. *Journal of computer assisted tomography*; 2019.

739. Tran, Gui, Cowling, Paul, Smith, Toby, Bury, Julie, Lucas, Adam, Barr, Andrew, Kingsbury, Sarah R, Conaghan, Philip G. What Imaging-Detected Pathologies Are Associated With Shoulder Symptoms and Their Persistence? A Systematic Literature Review. *Arthritis care & research*; 2018.

740. Lee, Jung-Sang, Do, Jong Geol, Yoon, Kyung Jae, Chae, Seoung Wan, Park, Hee-Jin, Park, Chul-Hyun, Lee, Yong-Taek. Voxel-based three-dimensional Segmentation of the capsulo-synovium from contrast-enhanced MRi can Represent clinical impairments in Adhesive capsulitis. *Scientific reports*; 2020.

741. Ahn K-S, Kang CH,Kim Y,Jeong W-K. Diagnosis of adhesive capsulitis: comparison of contrast-enhanced MRI with noncontrast-enhanced MRI. *Clinical imaging*; 2015.

742. Ahn, Kyung-Sik, Kang, Chang Ho, Oh, Yu-Whan, Jeong, Woong-Kyo. Correlation between magnetic resonance imaging and clinical impairment in patients with adhesive capsulitis. *Skeletal radiology*; 2012.

743. Carbone, Stefano, Napoli, Alessandro, Gumina, Stefano. MRI of adhesive capsulitis of the shoulder: distension of the bursa in the superior subscapularis recess is a suggestive sign of the pathology. *European journal of radiology*; 2014.

744. Chellathurai, Amarnath, Subbiah, Komalavalli, Elangovan, Atchaya, Kannappan, Sivakumar. Adhesive capsulitis: MRI correlation with clinical stages and proposal of MRI staging. *The Indian journal of radiology & imaging*; 2019.

745. Chi, Andrew S, Kim, John, Long, Suzanne S, Morrison, William B, Zoga, Adam C. Non-contrast MRI diagnosis of adhesive capsulitis of the shoulder. *Clinical imaging*; 2017.

746. Choi Y-H, Kim DH. Correlations between clinical features and MRI findings in early adhesive capsulitis of the shoulder: a retrospective observational study. *BMC Musculoskeletal Disorders*; 2020.

747. Connell, David, Padmanabhan, Ravi, Buchbinder, Rachelle. Adhesive capsulitis: role of MR imaging in differential diagnosis. *European radiology*; 2002.

748. Gokalp, Gokhan, Algin, Oktay, Yildirim, Nalan, Yazici, Zeynep. Adhesive capsulitis: Contrast-enhanced shoulder MRI findings. *Journal of medical imaging and radiation oncology*; 2011.

749. Jung, Jae Hoon, Kim, Du Hwan, Yi, Jaehyuck, Kim, Du-Han, Cho, Chul-Hyun. Determination of magnetic resonance imaging criteria for diagnosis of adhesive capsulitis. *Rheumatology international*; 2019.

750. Kanazawa, Kenji, Hagiwara, Yoshihiro, Sekiguchi, Takuya, Suzuki, Kazuaki, Koide, Masashi, Ando, Akira, Yabe, Yutaka. Correlations between Capsular Changes and ROM Restriction in Frozen Shoulder Evaluated by Plain MRI and MR Arthrography. *The open orthopaedics journal*; 2018.

751. Lee, S. Y., Park, J., Song, S. W. Correlation of MR arthrographic findings and range of shoulder motions in patients with frozen shoulder. *AJR Am J Roentgenol*; Jan 2012.

752. Lefevre-Colau, Marie-Martine, Drapé, Jean-Luc, Fayad, Fouad, Rannou, Francois, Diche, Thierry, Minvielle, Francois, Demaille-Wlodyka, Samantha, Mayoux-Benhamou, Marie-Anne, Fermanian, Jacques, Poiraudeau, Serge. Magnetic resonance imaging of shoulders with idiopathic adhesive capsulitis: reliability of measures. *European radiology*; 2005.

753. Li, Jin-qing, Tang, Kang-lai, Wang, Jian, Li, Qi-yu, Xu, Hao-tong, Yang, Hui-feng, Tan, Li-wen, Liu, Kai-jun, Zhang, Shao-xiang. MRI findings for frozen shoulder evaluation: is the thickness of the coracohumeral ligament a valuable diagnostic tool? *PLoS One*; 2011.

754. Park, Gi-Young, Park, Jung Hyun, Kwon, Dong Rak, Kwon, Dae Gil, Park, Jinyoung. Do the findings of magnetic resonance imaging, arthrography, and ultrasonography reflect clinical impairment in patients with idiopathic adhesive capsulitis of the shoulder? *Archives of physical medicine and rehabilitation*; 2017.

755. Park, Jina, Choi, Yoon-Hee, Chai, Jee Won, Cha, Seung Woo, Lim, Joo Hee, Jo, Chris Hyunchul, Kim, Dong Hyun. Anterior capsular abnormality: another important MRI finding for the diagnosis of adhesive capsulitis of the shoulder. *Skeletal radiology*; 2019.

756. Sasanuma, Hideyuki, Sugimoto, Hideharu, Fujita, Akifumi, Kanaya, Yuji, Iijima, Yuki, Saito, Toshihiro, Takeshita, Katsushi. Characteristics of dynamic magnetic resonance imaging of idiopathic severe frozen shoulder. *Journal of shoulder and elbow surgery*; 2017.

757. Sasanuma, Hideyuki, Sugimoto, Hideharu, Iijima, Yuki, Kanaya, Yuji, Saito, Tomohiro, Takeshita, Katsushi. Blood flow evaluation by dynamic magnetic resonance imaging of symptomatic rotator cuff tears and frozen shoulders. *Journal of shoulder and elbow surgery*; 2018.

758. Sernik, Renato A, Vidal Leão, Renata, Luis Bizetto, Eduardo, Sanford Damasceno, Rodrigo, Horvat, Natally, Guido Cerri, Giovanni. Thickening of the axillary recess capsule on ultrasound correlates with magnetic resonance imaging signs of adhesive capsulitis. *Ultrasound*; 2019.

759. Sofka, Carolyn M, Ciavarra, Gina A, Hannafin, Jo A, Cordasco, Frank A, Potter, Hollis G. Magnetic resonance imaging of adhesive capsulitis: correlation with clinical staging. *HSS Journal®*; 2008.

760. Suh, Chong Hyun, Yun, Seong Jong, Jin, Wook, Lee, Sun Hwa, Park, So Young, Park, Ji Seon, Ryu, Kyung Nam. Systematic review and meta-analysis of magnetic resonance imaging features for diagnosis of adhesive capsulitis of the shoulder. *European radiology*; 2019.

761. Teixeira, Pedro A Gondim, Balaj, Clémence, Chanson, Anne, Lecocq, Sophie, Louis, Matthias, Blum, Alain. Adhesive capsulitis of the shoulder: value of inferior glenohumeral ligament signal changes on T2-weighted fat-saturated images. *American Journal of Roentgenology*; 2012.

762. Zhao, Wen, Zheng, Xiaofeng, Liu, Yuying, Yang, Wenlu, Amirbekian, Vardan, Diaz, Luis E, Huang, Xudong. An MRI study of symptomatic adhesive capsulitis. *PLoS One*; 2012.

763. Pessis, E., Mihoubi, F., Feydy, A., Campagna, R., Guerini, H., Roren, A., Rannou, F., Drape, J. L., Lefevre-Colau, M. M. Usefulness of intravenous contrast-enhanced MRI for diagnosis of adhesive capsulitis. *Eur Radiol*; Nov 2020.

764. Mengiardi, Bernard, Pfirrmann, Christian WA, Gerber, Christian, Hodler, Jurg, Zanetti, Marco. Frozen shoulder: MR arthrographic findings. *Radiology*; 2004.

765. Geoffrey L. Manton, Mark E. Schweitzer,Dominik Weishaupt,David Karasick. Utility of MR arthrography in the diagnosis of adhesive capsulitis. *Skeletal Radiol*; 2001.

766. Ogul H, Tas N,Tuncer K,Polat G,Ogul Y,Pirimoglu B,Kantarci M. 3D volumetric MR arthrographic assessment of shoulder joint capacity in patients with primary adhesive capsulitis. *Br J Radiol*; 2019.

767. Isabelle Steurer-Dober , MD Kaspar Rufi bach ,PhD Juerg Hodler ,MD ,MBA Nadja Saupe ,MD Marco Zanetti ,MD Sandro F. Fucentese ,MD Christian W. A. Pfi rrmann ,MD ,MBA. Do Patients with Structural Abnormalities of the Shoulder Experience Pain after MR Arthrography of the Shoulder? *Radiology*; 2010.

768. Jung, J. Y., Jee, W. H., Chun, H. J., Kim, Y. S., Chung, Y. G., Kim, J. M. Adhesive capsulitis of the shoulder: evaluation with MR arthrography. *Eur Radiol*; Apr 2006.

769. Kim, K. C., Rhee, K. J., Shin, H. D. Adhesive capsulitis of the shoulder: dimensions of the rotator interval measured with magnetic resonance arthrography. *J Shoulder Elbow Surg*; May-Jun 2009.

770. Lee, K. H., Park, H. J., Lee, S. Y., Youn, I. Y., Kim, E., Park, J. H., Park, S. J. Adhesive Capsulitis of the Shoulder Joint: Value of Glenohumeral Distance on Magnetic Resonance Arthrography. *J Comput Assist Tomogr*; Jan 2017.

771. Song, K. D., Kwon, J. W., Yoon, Y. C., Choi, S. H. Indirect MR arthrographic findings of adhesive capsulitis. *AJR Am J Roentgenol*; Dec 2011.

772. Mehmet Halit Yilmaz, Fatih Kantarci,Ibrahim Adaletli,Sila Ulus,Fatih Gulsen,Harun Ozer,Ilknur Aktas,Kenan Akgun,Kaya Kanberoglu. Pain & resistance in patients with adhesive capsulitis during contrast material injection phase of MR arthrography. *Indian J Med Res*; 2007.

773. Min Hee Lee, MD,Joong Mo Ahn,MD,Claus Muhle,MD,Sung Hyun Kim,MD,Ji Seon Park,MD,Seung Ho Kim,MD,Sung Moon Kim,MD and Heung Sik Kang,MD. Adhesive Capsulitis of the Shoulder Diagnosis Using Magnetic Resonance Arthrography, with Arthroscopic Findings as the Standard. *J Comput Assist Tomogr*; 2003.

774. Ogul, H., Kantarci, M., Topal, M., Karaca, L., Tuncer, K., Pirimoglu, B., Okur, A., Yildirim, O. S., Levent, A. Extra-articular contrast material leaks into locations unrelated to the injection path in shoulder MR arthrography. *Eur Radiol*; Oct 2014.

775. Yoon, J. P., Chung, S. W., Lee, B. J., Kim, H. S., Yi, J. H., Lee, H. J., Jeong, W. J., Moon, S. G., Oh, K. S., Yoon, S. T. Correlations of magnetic resonance imaging findings with clinical symptom severity and prognosis of frozen shoulder. *Knee Surg Sports Traumatol Arthrosc*; Oct 2017.

776. Porat, S., Leupold, J. A., Burnett, K. R., Nottage, W. M. Reliability of non-imaging-guided glenohumeral joint injection through rotator interval approach in patients undergoing diagnostic MR arthrography. *AJR Am J Roentgenol*; Sep 2008.

777. Ryan, V., Brown, H., Minns Lowe, C. J., Lewis, J. S. The pathophysiology associated with primary (idiopathic) frozen shoulder: A systematic review. *BMC Musculoskelet Disord*; Aug 15 2016.

778. Tandon, Anupama, Dewan, Sakshi, Bhatt, Shuchi, Jain, A. K., Kumari, Rima. Sonography in diagnosis of adhesive capsulitis of the shoulder: a case-control study. *Journal of ultrasound*; 2017.

779. Duchstein, L. D. L., Jakobsen, J. R., Marker, L., Okholm, M., Friberg, L., Simonsen, L., Krogsgaard, M. R. The role of (18)F-FDG PET/CT in the diagnosis of frozen shoulder. *Knee Surg Sports Traumatol Arthrosc*; Jan 2021.

780. Sridharan, R., Engle, M. P., Garg, N., Wei, W., Amini, B. Focal uptake at the rotator interval or inferior capsule of shoulder on (18)F-FDG PET/CT is associated with adhesive capsulitis. *Skeletal Radiol*; Apr 2017.

781. Ogilvie-Harris, D. J., Biggs, D. J., Fitsialos, D. P., MacKay, M. The resistant frozen shoulder. Manipulation versus arthroscopic release. *Clin Orthop Relat Res*; Oct 1995.

782. Noel, E., Thomas, T., Schaeverbeke, T., Thomas, P., Bonjean, M., Revel, M. Frozen shoulder. *Joint Bone Spine*; 2000.

783. van Royen, B. J., Pavlov, P. W. Treatment of frozen shoulder by distension and manipulation under local anaesthesia. *Int Orthop*; 1996.

784. Omari, A., Bunker, T. D. Open surgical release for frozen shoulder: surgical findings and results of the release. *J Shoulder Elbow Surg*; Jul-Aug 2001.

785. Saccomanni, B. Inflammation and shoulder pain--a perspective on rotator cuff disease, adhesive capsulitis, and osteoarthritis: conservative treatment. *Clin Rheumatol*; May 2009.

786. Fareed, D. O., Gallivan, W. R.,Jr. Office management of frozen shoulder syndrome. Treatment with hydraulic distension under local anesthesia. *Clin Orthop Relat Res*; May 1989.

787. Gam, A. N., Schydlowsky, P., Rossel, I., Remvig, L., Jensen, E. M. Treatment of "frozen shoulder" with distension and glucorticoid compared with glucorticoid alone. A randomised controlled trial. *Scand J Rheumatol*; 1998.

788. Waldburger, M., Meier, J. L., Gobelet, C. The frozen shoulder: diagnosis and treatment. Prospective study of 50 cases of adhesive capsulitis. *Clin Rheumatol*; Sep 1992.

789. Hamer, J., Kirk, J. A. Physiotherapy and the frozen shoulder: a comparative trial of ice and ultrasonic therapy. *N Z Med J*; Mar 24 1976.

790. Lee, P. N., Lee, M., Haq, A. M., Longton, E. B., Wright, V. Periarthritis of the shoulder. Trial of treatments investigated by multivariate analysis. *Ann Rheum Dis*; Mar 1974.

791. Leung, M. S., Cheing, G. L. Effects of deep and superficial heating in the management of frozen shoulder. *J Rehabil Med*; Feb 2008.

792. Ranalletta, Maximiliano, Rossi, Luciano A, Bongiovanni, Santiago L, Tanoira, Ignacio, Elizondo, Cristina M, Maignon, Gastón D. Corticosteroid injections accelerate pain relief and recovery of function compared with oral NSAIDs in patients with adhesive capsulitis: a randomized controlled trial. *The American journal of sports medicine*; 2016.

793. Wang, Wei, Shi, Mingmin, Zhou, Chenhe, Shi, Zhongli, Cai, Xunzi, Lin, Tiao, Yan, Shigui. Effectiveness of corticosteroid injections in adhesive capsulitis of shoulder: A meta-analysis. *Medicine*; 2017.

794. Rizk, T. E., Pinals, R. S. Frozen shoulder. *Semin Arthritis Rheum*; May 1982.

795. Loew, M., Heichel, T. O., Lehner, B. Intraarticular lesions in primary frozen shoulder after manipulation under general anesthesia. *J Shoulder Elbow Surg*; Jan-Feb 2005.

796. Patel, B. R. A comparative study of subsyde-CR versus meloxicam in rheumatic disorders. *J Indian Med Assoc*; May 2000.

797. Saeidian, S. R., Hemmati, A. A., Haghighi, M. H. Pain relieving effect of short-course, pulse prednisolone in managing frozen shoulder. *J Pain Palliat Care Pharmacother*; 2007.

798. Buchbinder, R., Green, S., Youd, J. M., Johnston, R. V. Oral steroids for adhesive capsulitis. *Cochrane Database Syst Rev*; 2006.

799. Blockey, N. J., Wright, J. K., Kellgren, J. H. Oral cortisone therapy in periarthritis of the shoulder; a controlled trial. *Br Med J*; Jun 26 1954.

800. Widiastuti-Samekto, M., Sianturi, G. P. Frozen shoulder syndrome: comparison of oral route corticosteroid and intra-articular corticosteroid injection. *Med J Malaysia*; Aug 2004.

801. Ferrante, M. A., Ferrante, N. D. The thoracic outlet syndromes: Part 1. Overview of the thoracic outlet syndromes and review of true neurogenic thoracic outlet syndrome. *Muscle Nerve*; Jun 2017.

802. Ferrante, M. A., Ferrante, N. D. The thoracic outlet syndromes: Part 2. The arterial, venous, neurovascular, and disputed thoracic outlet syndromes. *Muscle Nerve*; Oct 2017.

803. Kaplan, J., Kanwal, A. Thoracic Outlet Syndrome. *StatPearls*; 2021.

804. Illig, K. A., Rodriguez-Zoppi, E. How Common Is Thoracic Outlet Syndrome? *Thorac Surg Clin*; Feb 2021.

805. Illig, KA,Donahue,D,Duncan,A,et al. Reporting standards of the Society for Vascular Surgery for thoracic outlet syndrome. Journal of vascular surgery. *Journal of Vascular Surgery*; 2016.

806. Thompson, RW. Development of consensus-based diagnostic criteria for NTOS. *Thoracic Outlet Syndrome*; 2013.

807. Vanti, C., Natalini, L., Romeo, A., Tosarelli, D., Pillastrini, P. Conservative treatment of thoracic outlet syndrome. A review of the literature. *Eura Medicophys*; Mar 2007.

808. Demirbag, D., Unlu, E., Ozdemir, F., Genchellac, H., Temizoz, O., Ozdemir, H., Demir, M. K. The relationship between magnetic resonance imaging findings and postural maneuver and physical examination tests in patients with thoracic outlet syndrome: results of a double-blind, controlled study. *Arch Phys Med Rehabil*; Jul 2007.

809. Sanders, R. J., Haug, C. Subclavian vein obstruction and thoracic outlet syndrome: a review of etiology and management. *Ann Vasc Surg*; Jul 1990.

810. Nord, K. M., Kapoor, P., Fisher, J., Thomas, G., Sundaram, A., Scott, K., Kothari, M. J. False positive rate of thoracic outlet syndrome diagnostic maneuvers. *Electromyogr Clin Neurophysiol*; Mar 2008.

811. Mackinnon, S. E., Novak, C. B. Evaluation of the patient with thoracic outlet syndrome. *Semin Thorac Cardiovasc Surg*; Apr 1996.

812. Cho, Young Jae, Lee, Hyuk Jin, Gong, Hyun Sik, Rhee, Seung Hwan, Park, Sang Jae, Baek, Goo Hyun. The radiologic relationship of the shoulder girdle to the thorax as an aid in diagnosing neurogenic thoracic outlet syndrome. *The Journal of hand surgery*; 2012.

813. Bilbey, JH, Müller, NL, Connell, DG, Luoma, AA, Nelems, B. Thoracic outlet syndrome: evaluation with CT. *Radiology*; 1989.

814. Remy-Jardin, Martine, Remy, Jacques, Masson, Pascal, Bonnel, François, Debatselier, Philippe, Vinckier, Ludmilla, Duhamel, Alain. Helical CT angiography of thoracic outlet syndrome: functional anatomy. *American Journal of Roentgenology*; 2000.

815. Gillard, Jérôme, Pérez-Cousin, Maryse, Hachulla, Éric, Remy, Jacques, Hurtevent, Jean-François, Vinckier, Ludmila, Thévenon, André, Duquesnoy, Bernard. Diagnosing thoracic outlet syndrome: contribution of provocative tests, ultrasonography, electrophysiology, and helical computed tomography in 48 patients. *Joint Bone Spine*; 2001.

816. Hasanadka, Ravishankar, Towne, Jonathan B, Seabrook, Gary R, Brown, Kellie R, Lewis, Brian D, Foley, W Dennis. Computed tomography angiography to evaluate thoracic outlet neurovascular compression. *Vascular and endovascular surgery*; 2007.

817. Greenberg, Joshua I, Alix, Kristen, Nehler, Mark R, Johnston, Robert J, Brantigan, Charles O. Computed tomography-guided reoperation for neurogenic thoracic outlet syndrome. *Journal of vascular surgery*; 2015.

818. Center, Gonda Vascular, Jordan, Sheldon E. Combining ultrasonography and electromyography for botulinum chemodenervation treatment of thoracic outlet syndrome: comparison with fluoroscopy and electromyography guidance. *Pain Physician*; 2007.

819. Passero, S, Paradiso, C, Giannini, F, Cioni, R, Burgalassi, L, Battistini, N. Diagnosis of thoracic outlet syndrome Relative value of electrophysiological studies. *Acta neurologica scandinavica*; 1994.

820. Panegyres, Peter K, Moore, Niall, Gibson, Rod, Rushworth, Geoffrey, Donaghy, Michael. Thoracic outlet syndromes and magnetic resonance imaging. *Brain*; 1993.

821. Demondion, X, Boutry, N, Drizenko, A, Paul, C, Francke, JP, Cotten, A. Thoracic outlet: anatomic correlation with MR imaging. *American Journal of Roentgenology*; 2000.

822. Demondion, Xavier, Bacqueville, Eric, Paul, Christelle, Duquesnoy, Bernard, Hachulla, Eric, Cotten, Anne. Thoracic outlet: assessment with MR imaging in asymptomatic and symptomatic populations. *Radiology*; 2003.

823. Smedby, Örjan, Rostad, H, Klaastad, Ø, Lilleås, F, Tillung, T, Fosse, E. Functional imaging of the thoracic outlet syndrome in an open MR scanner. *European radiology*; 2000.

824. Ersoy, Hale, Steigner, Michael L, Coyner, Karl B, Gerhard-Herman, Marie D, Rybicki, Frank J, Bueno, Raphael, Nguyen, Louis L. Vascular thoracic outlet syndrome: protocol design and diagnostic value of contrast-enhanced 3D MR angiography and equilibrium phase imaging on 1.5-and 3-T MRI scanners. *American Journal of Roentgenology*; 2012.

825. Lim, Ruth P, Bruno, Mary, Rosenkrantz, Andrew B, Kim, Danny C, Mulholland, Thomas, Kwon, Jane, Palfrey, Amy P, Ogedegbe, Olugbenga. Comparison of blood pool and extracellular gadolinium chelate for functional MR evaluation of vascular thoracic outlet syndrome. *European journal of radiology*; 2014.

826. Singh, Vinay Kumar, Jeyaseelan, Luckshmana, Kyriacou, Steve, Ghosh, Subhojit, Sinisi, Marco, Fox, Michael. Diagnostic value of magnetic resonance imaging in thoracic outlet syndrome. *Journal of Orthopaedic Surgery*; 2014.

827. Hardy, Alexandre, Pougès, Cécile, Wavreille, Guillaume, Behal, Hélène, Demondion, Xavier, Lefebvre, Guillaume. Thoracic outlet syndrome: diagnostic accuracy of MRI. *Orthopaedics & Traumatology: Surgery & Research*; 2019.

828. Zhang, Tonghua, Xu, Zhengdao, Chen, Jianxin, Liu, Zongbao, Wang, Tao, Hu, Yijiang, Shen, Liping, Xue, Feifei. A Novel Approach for Imaging of Thoracic Outlet Syndrome Using Contrast-Enhanced Magnetic Resonance Angiography (CE-MRA), Short Inversion Time Inversion Recovery Sampling Perfection with Application-Optimized Contrasts Using Different Flip Angle Evolutions (T2-STIR-SPACE), and Volumetric Interpolated Breath-Hold Examination (VIBE). *Medical science monitor: international medical journal of experimental and clinical research*; 2019.

829. Longley, DG, Yedlicka, JW, Molina, EJ, Schwabacher, S, Hunter, DW, Letourneau, JG. Thoracic outlet syndrome: evaluation of the subclavian vessels by color duplex sonography. *AJR. American journal of roentgenology*; 1992.

830. Molina, J Emesto, D'Cunha, Jonathan. The vascular component in neurogenic-arterial thoracic outlet syndrome. *International Journal of Angiology*; 2008.

831. Fried, Scott M, Nazarian, Levon N. Dynamic neuromusculoskeletal ultrasound documentation of brachial plexus/thoracic outlet compression during elevated arm stress testing. *Hand*; 2013.

832. Arányi, Zsuzsanna, Csillik, Anita, Böhm, Josef, Schelle, Thomas. Ultrasonographic identification of fibromuscular bands associated with neurogenic thoracic outlet syndrome: the "wedge-sickle" sign. *Ultrasound in medicine & biology*; 2016.

833. Orlando, Megan S, Likes, Kendall C, Mirza, Serene, Cao, Yue, Cohen, Anne, Lum, Ying Wei, Freischlag, Julie A. Preoperative duplex scanning is a helpful diagnostic tool in neurogenic thoracic outlet syndrome. *Vascular and endovascular surgery*; 2016.

834. Weaver, M Libby, Lum, Ying Wei. New diagnostic and treatment modalities for neurogenic thoracic outlet syndrome. *Diagnostics*; 2017.

835. Adam, Garret, Wang, Kevin, Demaree, Christopher J, Jiang, Jenny S, Cheung, Mathew, Bechara, Carlos F, Lin, Peter H. A prospective evaluation of duplex ultrasound for thoracic outlet syndrome in high-performance musicians playing bowed string instruments. *Diagnostics*; 2018.

836. Nassar, Nagwa M, Yasaky, Ahmed Z, Farrag, Dina A, Magdy, Medhat M. The value of neuromuscular ultrasound in relation to clinical and electrophysiological testing in the diagnosis of thoracic outlet syndrome. *Egyptian Rheumatology and Rehabilitation*; 2018.

837. Kim, Tanner I, Sarac, Timur P, Orion, Kristine C. Intravascular ultrasound in venous thoracic outlet syndrome. *Annals of vascular surgery*; 2019.

838. Brownie, Evan R, Abuirqeba, Ahmmad A, Ohman, J Westley, Rubin, Brian G, Thompson, Robert W. False-negative upper extremity ultrasound in the initial evaluation of patients with suspected subclavian vein thrombosis due to thoracic outlet syndrome (Paget-Schroetter syndrome). *Journal of Vascular Surgery: Venous and Lymphatic Disorders*; 2020.

839. Pesser, Niels, Teijink, Joep AW, Vervaart, Kimberly, Goeteyn, Jens, Gons, Rob AR, van Sambeek, Marc RHM, van Nuenen, Bart FL. Value of ultrasound in the diagnosis of neurogenic thoracic outlet syndrome. *European Journal of Vascular and Endovascular Surgery*; 2020.

840. Bishop, Lily, Bartlett, Matthew. Doppler waveform analysis during provocative manoeuvres in the assessment for arterial thoracic outlet syndrome results in high false-positive rates; a cross-sectional study. *JRSM Cardiovascular Disease*; 2021.

841. Farina, Renato, Foti, Pietro Valerio, Conti, Andrea, Iannace, Francesco Aldo, Pennisi, Isabella, Fanzone, Luigi, Inì, Corrado, Libra, Federica, Vacirca, Francesco, Failla, Giovanni. The role of ultrasound imaging in vascular compression syndromes. *The Ultrasound Journal*; 2021.

842. Fouasson-Chailloux, Alban, Menu, Pierre, Daley, Pauline, Gautier, Giovanni, Gadbled, Guillaume, Abraham, Pierre, Dauty, Marc. Subclavian Vessel Compression Assessed by Duplex Scanning in Patients with Neurogenic Thoracic Outlet Syndrome and No Vascular Signs. *Diagnostics*; 2021.

843. Hu, Jian, Biederman, Robert, Kashyap, Kartikeya, Wilson, John Travis, Farah, Victor, Franco, Todd, Nguyen, Vinh. Duplex ultrasound in the evaluation of venous and arterial thoracic outlet syndrome. *JRSM open*; 2021.

844. Nakatsuchi, Y., Saitoh, S., Hosaka, M., Matsuda, S. Conservative treatment of thoracic outlet syndrome using an orthosis. *J Hand Surg Br*; Feb 1995.

845. Christo, P. J., Christo, D. K., Carinci, A. J., Freischlag, J. A. Single CT-guided chemodenervation of the anterior scalene muscle with botulinum toxin for neurogenic thoracic outlet syndrome. *Pain Med*; Apr 2010.

846. Finlayson, H. C., O'Connor, R. J., Brasher, P. M. A., Travlos, A. Botulinum toxin injection for management of thoracic outlet syndrome: a double-blind, randomized, controlled trial. *Pain*; Sep 2011.

847. Foley, J. M., Finlayson, H., Travlos, A. A review of thoracic outlet syndrome and the possible role of botulinum toxin in the treatment of this syndrome. *Toxins (Basel)*; Nov 7 2012.

848. Godoy, Ivan RB, Donahue, Dean M, Torriani, Martin. Botulinum toxin injections in musculoskeletal disorders. *Seminars in musculoskeletal radiology*; 2016.

849. Lee, G. W., Kwon, Y. H., Jeong, J. H., Kim, J. W. The efficacy of scalene injection in thoracic outlet syndrome. *J Korean Neurosurg Soc*; Jul 2011.

850. Weaver, M. L., Hicks, C. W., Fritz, J., Black, J. H.,3rd, Lum, Y. W. Local Anesthetic Block of the Anterior Scalene Muscle Increases Muscle Height in Patients With Neurogenic Thoracic Outlet Syndrome. *Ann Vasc Surg*; Aug 2019.

851. Franklin, G. M., Fulton-Kehoe, D., Bradley, C., Smith-Weller, T. Outcome of surgery for thoracic outlet syndrome in Washington state workers' compensation. *Neurology*; Mar 28 2000.

852. Goff, C. D., Parent, F. N., Sato, D. T., Robinson, K. D., Gregory, R. T., Gayle, R. G., Demasi, R. J., Meier, G. H., Reid, J. W.,Jr., Wheeler, J. R. A comparison of surgery for neurogenic thoracic outlet syndrome between laborers and nonlaborers. *Am J Surg*; Aug 1998.

853. Green, R. M., McNamara, J., Ouriel, K. Long-term follow-up after thoracic outlet decompression: an analysis of factors determining outcome. *J Vasc Surg*; Dec 1991.

854. Chang, Edward S. Accuracy of magnetic resonance imaging in predicting the intraoperative tear characteristics of pectoralis major ruptures. *Journal of Shoulder and Elbow Surgery*; 2016.

855. Wise, PM,Ptasinski,AM,Gallo,RA. Pectoralis Major Ruptures in the National Football League: Incidence, RTP, and Performance Analysis. *Orthop J Sports Med*; 2021.

856. Bodendorfer, B. M., McCormick, B. P., Wang, D. X., Looney, A. M., Conroy, C. M., Fryar, C. M., Kotler, J. A., Ferris, W. J., Postma, W. F., Chang, E. S. Treatment of Pectoralis Major Tendon Tears: A Systematic Review and Meta-analysis of Operative and Nonoperative Treatment. *Orthop J Sports Med*; Feb 2020.

857. Abrams, G. D., Gupta, A. K., Hussey, K. E., Tetteh, E. S., Karas, V., Bach, B. R.,Jr., Cole, B. J., Romeo, A. A., Verma, N. N. Arthroscopic Repair of Full-Thickness Rotator Cuff Tears With and Without Acromioplasty: Randomized Prospective Trial With 2-Year Follow-up. *Am J Sports Med*; Apr 14 2014.

858. Hauschild, VD,Forrest,LJ,Hirleman,C,et al. Pectoralis Major Injuries in the Army, CY 2016 Active Duty Army APHC PHIP No. 12-03-0719. *Army Public Health Ctr*; 2019.

859. Salazar, D., Shakir, I., Joe, K., Choate, W. S. Acute Pectoralis Major Tears in Forward Deployed Active Duty U.S. Military Personnel: A Population at Risk? *J Surg Orthop Adv*; Summer 2019.

860. Shaw, K. A., Brown, S., Moreland, C. M., Antosh, I. J., Parada, S. A. Parachute-Induced Pectoralis Major Tears in Military Servicemembers: What Is the Functional Recovery? *Orthop J Sports Med*; Jun 2021.

861. Crass, J. R., Craig, E. V., Bretzke, C., Feinberg, S. B. Ultrasonography of the rotator cuff. *Radiographics*; Nov 1985.

862. Whitehead, N,Mohammed,K,Fulcher,M. Does the Beighton score correlate with specific measures of shoulder joint laxity? *Orthop J Sports Med*; 2018.

863. White, A,Patel,N,Hadley,C,Dodson,C. An Algorithmic Approach to the Management of Shoulder Instability. *J Am Acad Orthop Surg Glob Res Rev*; 2019.

864. Provencher, M,Bhatia,S,Ghodadra,N. Recurrent shoulder instability: Current concepts for evaluation and management of glenoid bone loss. *J Bone Joint Surg Am*; 2010.

865. Wang, S. Management of the First-time Traumatic Anterior Shoulder Dislocation. *Clin Shoulder Elb*; 2018.

866. Luime, J. J., Verhagen, A. P., Miedema, H. S., Kuiper, J. I., Burdorf, A., Verhaar, J. A., Koes, B. W. Does this patient have an instability of the shoulder or a labrum lesion? *Jama*; Oct 27 2004.

867. Friedman, R. J., Blocker, E. R., Morrow, D. L. Glenohumeral instability. *J South Orthop Assoc*; Fall 1995.

868. Sherbondy, P. S., McFarland, E. G. Shoulder instability in the athlete. *Phys Med Rehabil Clin N Am*; Nov 2000.

869. Zamora-Navas, P., Borras Verdera, A., Porras Garcia, J., Padilla Marquez, A., Linares, P. Long-term results of the Boytchev procedure for the treatment of recurrent dislocation of the shoulder. *Acta Orthop Belg*; Jun 2001.

870. Taylor, DC,Arciero,RA. Pathologic changes associated with shoulder dislocations: Arthroscopic and physical examination findings in first-time, traumatic anterior dislocations. *Am J Sports Med*; 1997.

871. Yiannakopoulos, CK,Mataragas,E,Antonogiannakis,E. A comparison of the spectrum of intra-articular lesions in acute and chronic anterior shoulder instability. *Arthroscopy*; 2007.

872. Palmer, I,Widén,A. The bone block method for recurrent dislocation of the shoulder joint. *J Bone Joint Surg Br*; 1948.

873. Burkhart, S,DeBeer,J. Traumatic glenohumeral bone defects and their relationship to failure of arthroscopic Bankart repairs: Significance of the inverted-pear glenoid and the humeral engaging Hill-Sachs lesion. *Arthroscopy*; 2000.

874. Bishop, J,Jones,G,Rerko,M,Donaldson,C. 3-D CT is the most reliable imaging modality when quantifying glenoid bone loss. *Clin Orthop Relat Res*; 2013.

875. Blanchard, T. K., Bearcroft, P. W., Maibaum, A., Hazelman, B. L., Sharma, S., Dixon, A. K. Magnetic resonance imaging or arthrography for shoulder problems: a randomised study. *European Journal of Radiology*; 1999.

876. Weber, AE,Trasolini,NA,Mayer,EN,et al. Injections Prior to Rotator Cuff Repair Are Associated With Increased Rotator Cuff Revision Rates. *Arthroscopy*; 2019.

877. Agarwalla, A,Puzzitiello,RN,Mascarenhas,R,et al. Preoperative Injections May Be an Iatrogenic Cause of Reoperation After Arthroscopic Rotator Cuff Repair. *Arthroscopy*; 2019.

878. Traven SA, Brinton D,Simpson KN,et al. Preoperative Shoulder Injections Are Associated With Increased Risk of Revision Rotator Cuff Repair. *Arthroscopy*; 2019.

879. Desai, VS,Camp,CL,Boddapati,V,et al. Increasing Numbers of Shoulder Corticosteroid Injections Within a Year Preoperatively May Be Associated With a Higher Rate of Subsequent Revision Rotator Cuff Surgery. *Arthroscopy*; 2019.

880. Kiviluoto, O,Pasila,M,Jaroma,H,et al. Immobilization after primary dislocation of the shoulder. *Acta Orthop Scand*; 1980.

881. Itoi, E,Hatakeyama,Y,Kido,T,et al. A new method of immobilization after traumatic anterior dislocation of the shoulder: a preliminary study. *J Shoulder Elbow Surg*; 2003.

882. Itoi, E,Hatakeyama,Y,Sato,T,et al. Immobilization in external rotation after shoulder dislocation reduces the risk of recurrence. A randomized controlled trial. *J Bone Joint Surg Am*; 2007.

883. Gaballah, A,Zeyada,M,Elgeidi,A,et al. Six-week physical rehabilitation protocol for anterior shoulder dislocation in athletes. *J Exerc Rehabil*; 2017.

884. Riccio, I,de Sire,A,Latte,C,et al. Conservative treatment of traumatic shoulder instability: a case series study. *Musculoskelet Surg*; 2015.

885. Karzel, R. P., Snyder, S. J. Magnetic resonance arthrography of the shoulder. A new technique of shoulder imaging. *Clin Sports Med*; Jan 1993.

886. Smith, A. M., McCauley, T. R., Jokl, P. SLAP lesions of the glenoid labrum diagnosed with MR imaging. *Skeletal Radiol*; Oct 1993.

887. Nam, E. K., Snyder, S. J. The diagnosis and treatment of superior labrum, anterior and posterior (SLAP) lesions. *Am J Sports Med*; Sep-Oct 2003.

888. Enad, Jerome, Kurtz, Christopher. Isolated and combined Type II SLAP repairs in a military population. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2007.

889. D'Alessandro, DF, Fleischli, JE, Connor, PM. Superior labral lesions: diagnosis and management. *Journal of Athletic Training*; 2000.

890. Trantalis, JN, Lo, IKY. Superior labral anterior-posterior (SLAP) tears: recent advances and outcomes. *Current Orthopaedic Practice*; Sep-Oct 2008.

891. Dodson, C. C., Altchek, D. W. SLAP lesions: an update on recognition and treatment. *J Orthop Sports Phys Ther*; Feb 2009.

892. Keener, J. D., Brophy, R. H. Superior labral tears of the shoulder: pathogenesis, evaluation, and treatment. *The Journal Of The American Academy Of Orthopaedic Surgeons*; Oct 2009.

893. O'Brien, S. J., Warren, R. F., Schwartz, E. Anterior shoulder instability. *The Orthopedic Clinics Of North America*; Jul 1987.

894. O'Brien, S. J., Allen, A. A., Coleman, S. H., Drakos, M. C. The trans-rotator cuff approach to SLAP lesions: technical aspects for repair and a clinical follow-up of 31 patients at a minimum of 2 years. *Arthroscopy: The Journal Of Arthroscopic & Related Surgery: Official Publication Of The Arthroscopy Association Of North America And The International Arthroscopy Association*; Apr 2002.

895. Powell, SE, Nord, KD, Ryu, RKN. The diagnosis, classification, and treatment of SLAP lesions. *Operative Techniques in Sports Medicine*; 2004.

896. DaSilva, J, McNickle, AG, Cole, BJ. Arthroscopic superior labrum anterior to posterior repair. *Operative Techniques in Orthopaedics*; 2008.

897. Multanen, Juhani, Kiuru, Pauli, Piitulainen, Kirsi, Ylinen, Jari, Paloneva, Juha, Häkkinen, Arja. Enhanced rehabilitation guidance after arthroscopic capsulolabral repair of the shoulder: a randomized controlled trial. *Clinical Rehabilitation*; 2020.

898. Neri, Brian R., Vollmer, Emily A., Kvitne, Ronald S. Isolated Type II superior labral anterior posterior lesions: age-related outcome of arthroscopic fixation. *American Journal of Sports Medicine*; 2009.

899. Thorndike, A, Quigley, T. Injuries to the acromioclavicular joint: A plea for conservative treatment. *The American Journal of Surgery*; 1942.

900. Kaplan, L. D., Flanigan, D. C., Norwig, J., Jost, P., Bradley, J. Prevalence and variance of shoulder injuries in elite collegiate football players. *Am J Sports Med*; Aug 2005.

901. Post, M. Current concepts in the treatment of fractures of the clavicle. *Clin Orthop Relat Res*; Aug 1989.

902. Simovitch, R., Sanders, B., Ozbaydar, M., Lavery, K., Warner, J. J. Acromioclavicular joint injuries: diagnosis and management. *J Am Acad Orthop Surg*; Apr 2009.

903. Bergfeld, J. A., Andrish, J. T., Clancy, W. G. Evaluation of the acromioclavicular joint following first- and second-degree sprains. *Am J Sports Med*; Jul-Aug 1978.

904. Tossy, J. D., Mead, N. C., Sigmond, H. M. Acromioclavicular separations: useful and practical classification for treatment. *Clin Orthop Relat Res*; 1963.

905. Allman, F. L.,Jr. Fractures and ligamentous injuries of the clavicle and its articulation. *J Bone Joint Surg Am*; Jun 1967.

906. Rockwood, CA, Matsen, FA. The shoulder. *Frozen Shoulder*; 1990.

907. Rockwood, C. A.,Jr. The shoulder: facts, confusions and myths. *Int Orthop*; 1991.

908. Post, M. Current concepts in the diagnosis and management of acromioclavicular dislocations. *Clin Orthop Relat Res*; Nov 1985.

909. Kristiansen, B., Angermann, P., Larsen, T. K. Functional results following fractures of the proximal humerus. A controlled clinical study comparing two periods of immobilization. *Arch Orthop Trauma Surg*; 1989.

910. Lungberg, B. J., Svenungson-Hartwig, E., Wikmark, R. Independent exercises versus physiotherapy in nondisplaced proximal humeral fractures. *Scand J Rehabil Med*; 1979.

911. Bertoft, E. S., Lundh, I., Ringqvist, I. Physiotherapy after fracture of the proximal end of the humerus. Comparison between two methods. *Scand J Rehabil Med*; 1984.

912. Court-Brown, C. M., McQueen, M. M. The impacted varus (A2.2) proximal humeral fracture: prediction of outcome and results of nonoperative treatment in 99 patients. *Acta Orthop Scand*; Dec 2004.

913. Young, T. B., Wallace, W. A. Conservative treatment of fractures and fracture-dislocations of the upper end of the humerus. *J Bone Joint Surg Br*; May 1985.

914. Mills, H. J., Horne, G. Fractures of the proximal humerus in adults. *J Trauma*; Aug 1985.

915. Handoll, H. H., Gibson, J. N., Madhok, R. Interventions for treating proximal humeral fractures in adults. *Cochrane Database Syst Rev*; 2003.

916. Clifford, P. C. Fractures of the neck of the humerus: a review of the late results. *Injury*; Sep 1980.

917. Brostrom, F. Early mobilization of fractures of the upper end of the humerus. *Arch Surg*; 1943.

918. Hodgson, S. A., Mawson, S. J., Stanley, D. Rehabilitation after two-part fractures of the neck of the humerus. *J Bone Joint Surg Br*; Apr 2003.

919. Court-Brown, C. M., Cattermole, H., McQueen, M. M. Impacted valgus fractures (B1.1) of the proximal humerus. The results of non-operative treatment. *J Bone Joint Surg Br*; May 2002.

920. Kristiansen, B., Kofoed, H. Transcutaneous reduction and external fixation of displaced fractures of the proximal humerus. A controlled clinical trial. *J Bone Joint Surg Br*; Nov 1988.

921. Karatosun, V., Alekberov, C., Baran, O., Serin, E., Alici, E., Balci, C. Open fractures of the proximal humerus treated with the Ilizarov method: 12 patients followed 3-8 years. *Acta Orthop Scand*; Aug 2002.

922. Zyto, K., Kronberg, M., Brostrom, L. A. Shoulder function after displaced fractures of the proximal humerus. *J Shoulder Elbow Surg*; Sep-Oct 1995.

923. Jull, G. The role of passive mobilization in the immediate management of the fractured neck of humerus. *Australian J Physiotherapy*; 1979.

924. Einarsson, F. Fracture of the upper end of the humerus: discussion based on the follow-up of 302 cases. *Acta Orthop Scand Suppl*; 1958.

925. Postacchini, F., Gumina, S., De Santis, P., Albo, F. Epidemiology of clavicle fractures. *J Shoulder Elbow Surg*; Sep-Oct 2002.

926. Nordqvist, A., Petersson, C. The incidence of fractures of the clavicle. *Clin Orthop Relat Res*; Mar 1994.

927. Robinson, C. M. Fractures of the clavicle in the adult. Epidemiology and classification. *J Bone Joint Surg Br*; May 1998.

928. Neer, C. S.,2nd. Nonunion of the clavicle. *J Am Med Assoc*; Mar 5 1960.

929. Neviaser, R. J. Injuries to the clavicle and acromioclavicular joint. *Orthop Clin North Am*; Jul 1987.

930. Boehme, D., Curtis, R. J.,Jr., DeHaan, J. T., Kay, S. P., Young, D. C., Rockwood, C. A.,Jr. Non-union of fractures of the mid-shaft of the clavicle. Treatment with a modified Hagie intramedullary pin and autogenous bone-grafting. *J Bone Joint Surg Am*; Sep 1991.

931. Eiff, M. P. Management of clavicle fractures. *Am Fam Physician*; Jan 1997.

932. Der Tavitian, J., Davison, J. N., Dias, J. J. Clavicular fracture non-union surgical outcome and complications. *Injury*; Mar 2002.

933. Stanley, D., Norris, S. H. Recovery following fractures of the clavicle treated conservatively. *Injury*; May 1988.

934. Sankarankutty, M., Turner, B. W. Fractures of the clavicle. *Injury*; Nov 1975.

935. Zlowodzki, M., Zelle, B. A., Cole, P. A., Jeray, K., McKee, M. D. Treatment of acute midshaft clavicle fractures: systematic review of 2144 fractures: on behalf of the Evidence-Based Orthopaedic Trauma Working Group. *J Orthop Trauma*; Aug 2005.

936. Ada, J. R., Miller, M. E. Scapular fractures. Analysis of 113 cases. *Clin Orthop Relat Res*; Aug 1991.

937. Goss, T. P. Fractures of the glenoid cavity. *J Bone Joint Surg Am*; Feb 1992.

938. DeFranco, M. J., Patterson, B. M. The floating shoulder. *J Am Acad Orthop Surg*; Aug 2006.

939. Hardegger, F. H., Simpson, L. A., Weber, B. G. The operative treatment of scapular fractures. *J Bone Joint Surg Br*; Nov 1984.

940. van Noort, A., te Slaa, R. L., Marti, R. K., van der Werken, C. The floating shoulder. A multicentre study. *J Bone Joint Surg Br*; Aug 2001.

941. Labler, L., Platz, A., Weishaupt, D., Trentz, O. Clinical and functional results after floating shoulder injuries. *J Trauma*; Sep 2004.

942. Ramos, L, Mencia, R, Alonso, A, Ferrandez, L. Conservative treatment of ipsilateral fractures of the scapula and clavicle. *J Trauma,*; 1997.

943. Egol, K. A., Connor, P. M., Karunakar, M. A., Sims, S. H., Bosse, M. J., Kellam, J. F. The floating shoulder: clinical and functional results. *J Bone Joint Surg Am*; Aug 2001.

944. Owens, B. D., Goss, T. P. The floating shoulder. *J Bone Joint Surg Br*; Nov 2006.

945. Khan, L. A., Bradnock, T. J., Scott, C., Robinson, C. M. Fractures of the clavicle. *J Bone Joint Surg Am*; Feb 2009.

946. Safran, M. R. Nerve injury about the shoulder in athletes, part 2: long thoracic nerve, spinal accessory nerve, burners/stingers, thoracic outlet syndrome. *Am J Sports Med*; Jun 2004.

947. Shin, A. Y., Spinner, R. J., Steinmann, S. P., Bishop, A. T. Adult traumatic brachial plexus injuries. *J Am Acad Orthop Surg*; Oct 2005.

948. Midha, R. Epidemiology of brachial plexus injuries in a multitrauma population. *Neurosurgery*; Jun 1997.

949. Fletcher, I. Traction lesions of the brachial plexus. *Hand*; 1969.

950. Yeoman, P. M. & Seddon,H. J. Brachial plexus injuries: treatment of the flail arm. *J. Bone Joint Surg.*; 1961.

951. Kim, S. H., Ha, K. I., Jung, M. W., Lim, M. S., Kim, Y. M., Park, J. H. Accelerated rehabilitation after arthroscopic Bankart repair for selected cases: a prospective randomized clinical study. *Arthroscopy*; Sep 2003.

952. Teboul, F., Kakkar, R., Ameur, N., Beaulieu, J. Y., Oberlin, C. Transfer of fascicles from the ulnar nerve to the nerve to the biceps in the treatment of upper brachial plexus palsy. *J Bone Joint Surg Am*; Jul 2004.

953. Gu, Y. D., Ma, M. K. Use of the phrenic nerve for brachial plexus reconstruction. *Clin Orthop Relat Res*; Feb 1996.

954. Songcharoen, P., Mahaisavariya, B., Chotigavanich, C. Spinal accessory neurotization for restoration of elbow flexion in avulsion injuries of the brachial plexus. *J Hand Surg Am*; May 1996.

955. Songcharoen, P., Wongtrakul, S., Mahaisavariya, B., Spinner, R. J. Hemi-contralateral C7 transfer to median nerve in the treatment of root avulsion brachial plexus injury. *J Hand Surg Am*; Nov 2001.

956. Merrell, G. A., Barrie, K. A., Katz, D. L., Wolfe, S. W. Results of nerve transfer techniques for restoration of shoulder and elbow function in the context of a meta-analysis of the English literature. *J Hand Surg Am*; Mar 2001.

957. Ruch, D. S., Friedman, A., Nunley, J. A. The restoration of elbow flexion with intercostal nerve transfers. *Clin Orthop Relat Res*; May 1995.

958. Mikami, Y., Nagano, A., Ochiai, N., Yamamoto, S. Results of nerve grafting for injuries of the axillary and suprascapular nerves. *J Bone Joint Surg Br*; Jul 1997.

959. Akasaka, Y., Hara, T., Takahashi, M. Free muscle transplantation combined with intercostal nerve crossing for reconstruction of elbow flexion and wrist extension in brachial plexus injuries. *Microsurgery*; 1991.

960. Doi, K., Sakai, K., Fuchigami, Y., Kawai, S. Reconstruction of irreparable brachial plexus injuries with reinnervated free-muscle transfer. Case report. *J Neurosurg*; Jul 1996.

961. Doi, K. New reconstructive procedure for brachial plexus injury. *Clin Plast Surg*; Jan 1997.

962. Doi, K., Shigetomi, M., Kaneko, K., Soo-Heong, T., Hiura, Y., Hattori, Y., Kawakami, F. Significance of elbow extension in reconstruction of prehension with reinnervated free-muscle transfer following complete brachial plexus avulsion. *Plast Reconstr Surg*; Aug 1997.

963. Doi, K., Sakai, K., Kuwata, N., Ihara, K., Kawai, S. Double free-muscle transfer to restore prehension following complete brachial plexus avulsion. *J Hand Surg Am*; May 1995.

964. Doi, K., Sakai, K., Ihara, K., Abe, Y., Kawai, S., Kurafuji, Y. Reinnervated free muscle transplantation for extremity reconstruction. *Plast Reconstr Surg*; Apr 1993.

965. Manktelow, R. T., Zuker, R. M., McKee, N. H. Functioning free muscle transplantation. *J Hand Surg Am*; Jan 1984.

966. Edwards, J., Knowles, N. Superficial dry needling and active stretching in the treatment of myofascial pain--a randomised controlled trial. *Acupunct Med*; Sep 2003.

967. Diz, JBM,de Souza,JRLM,Leopoldino,AAO,et al. Exercise, especially combined stretching and strengthening exercise, reduces myofascial pain: a systematic review. *J Physiotherapy*; 2017.

968. Ahmed, S,Khattab,S,Haddad,C,et al. Effect of aerobic exercise in the treatment of myofascial pain: a systematic review. *J Exerc Rehabil*; 2018.

969. Taimini, IK. The Science of Yoga: The Yoga-sutras of Patanjali in Sanskrit with Transliteration in Roman, Translation and Commentary in English. 1986.

970. Williams, K. A., Petronis, J., Smith, D., Goodrich, D., Wu, J., Ravi, N., Doyle, E. J.,Jr., Gregory Juckett, R., Munoz Kolar, M., Gross, R., Steinberg, L. Effect of Iyengar yoga therapy for chronic low back pain. *Pain*; May 2005.

971. Sareen, S., Kumari, V., Gajebasia, K. S., Gajebasia, N. K. Yoga: a tool for improving the quality of life in chronic pancreatitis. *World J Gastroenterol*; Jan 21 2007.

972. Koes, B. W., Bouter, L. M., van Mameren, H., Essers, A. H., Verstegen, G. J., Hofhuizen, D. M., Houben, J. P., Knipschild, P. G. A randomized clinical trial of manual therapy and physiotherapy for persistent back and neck complaints: subgroup analysis and relationship between outcome measures. *J Manipulative Physiol Ther*; May 1993.

973. Koes, B. W., Bouter, L. M., van Mameren, H., Essers, A. H., Verstegen, G. M., Hofhuizen, D. M., Houben, J. P., Knipschild, P. G. The effectiveness of manual therapy, physiotherapy, and treatment by the general practitioner for nonspecific back and neck complaints. A randomized clinical trial. *Spine*; Jan 1992.

974. Koes, B. W., Bouter, L. M., van Mameren, H., Essers, A. H., Verstegen, G. M., Hofhuizen, D. M., Houben, J. P., Knipschild, P. G. Randomised clinical trial of manipulative therapy and physiotherapy for persistent back and neck complaints: results of one year follow up. *Bmj*; Mar 7 1992.

975. Hurwitz, E. L., Morgenstern, H., Harber, P., Kominski, G. F., Yu, F., Adams, A. H. A randomized trial of chiropractic manipulation and mobilization for patients with neck pain: clinical outcomes from the UCLA neck-pain study. *Am J Public Health*; Oct 2002.

976. Cleland, J. A., Glynn, P., Whitman, J. M., Eberhart, S. L., MacDonald, C., Childs, J. D. Short-term effects of thrust versus nonthrust mobilization/manipulation directed at the thoracic spine in patients with neck pain: a randomized clinical trial. *Phys Ther*; Apr 2007.

977. Sloop, P. R., Smith, D. S., Goldenberg, E., Dore, C. Manipulation for chronic neck pain. A double-blind controlled study. *Spine*; Nov-Dec 1982.

978. Wood, T. G., Colloca, C. J., Matthews, R. A pilot randomized clinical trial on the relative effect of instrumental (MFMA) versus manual (HVLA) manipulation in the treatment of cervical spine dysfunction. *J Manipulative Physiol Ther*; May 2001.

979. van Schalkwyk, R, Parkin-Smith, GF. A clinical trial investigating the possible effect of the supine cervical rotatory manipulation and the supine lateral break manipulation in the treatment of mechanical neck pain: a pilot study. *J Manipulative Physiol Ther*; 2000.

980. Bronfort, G., Evans, R., Nelson, B., Aker, P. D., Goldsmith, C. H., Vernon, H. A randomized clinical trial of exercise and spinal manipulation for patients with chronic neck pain. *Spine*; Apr 1 2001.

981. Giles, L. G., Muller, R. Chronic spinal pain: a randomized clinical trial comparing medication, acupuncture, and spinal manipulation. *Spine*; Jul 15 2003.

982. Skargren, E. I., Oberg, B. E., Carlsson, P. G., Gade, M. Cost and effectiveness analysis of chiropractic and physiotherapy treatment for low back and neck pain. Six-month follow-up. *Spine (Phila Pa 1976)*; Sep 15 1997.

983. Mintken, P. E., Cleland, J. A., Carpenter, K. J., Bieniek, M. L., Keirns, M., Whitman, J. M. Some factors predict successful short-term outcomes in individuals with shoulder pain receiving cervicothoracic manipulation: a single-arm trial. *Phys Ther*; Jan 2010.

984. Strunce, J. B., Walker, M. J., Boyles, R. E., Young, B. A. The immediate effects of thoracic spine and rib manipulation on subjects with primary complaints of shoulder pain. *J Man Manip Ther*; 2009.

985. Bergman, G. J., Winters, J. C., Groenier, K. H., Pool, J. J., Meyboom-de Jong, B., Postema, K., van der Heijden, G. J. Manipulative therapy in addition to usual medical care for patients with shoulder dysfunction and pain: a randomized, controlled trial. *Ann Intern Med*; Sep 21 2004.

986. Gemignani, G., Olivieri, I., Ruju, G., Pasero, G. Transcutaneous electrical nerve stimulation in ankylosing spondylitis: a double-blind study. *Arthritis Rheum*; Jun 1991.

987. van Tulder, M, Koes, B, Malmivaara, A. Outocme of non-invasive treatment modalities on back pain: an evidence-based review. *Eur Spine J*; 2006.

988. Long, DM. Fifteen years of transcutaneous electrical stimulation for pain control. *Stereotact Funct Neurosurg*; 1991.

989. Shealy, CN. Transcutaneous electrical nerve stimulation: the treatment of choice for pain and depression. *J Altern Complement Med*; 2003.

990. Richardson, RR, Arbit, J, Siqueira, EB, Zagar, R. Transcutaneous electrical neurostimulation in functional pain. *Spine (Phila Pa 1976)*; 1981.

991. Robinson, AJ. Transcutaneous electrical nerve stimulation for the control of pain in musculoskeletal disorders. *J Orthop Sports Phys Ther*; 1996.

992. Richardson, R. R., Siqueira, E. B. Transcutaneous electrical neurostimulation in postlaminectomy pain. *Spine (Phila Pa 1976)*; Jul-Aug 1980.

993. De Carli, Angelo, Pulcinelli, Ferdinando, Delle Rose, Giacomo, Pitino, Dario, Ferretti, Andrea. Calcific tendinitis of the shoulder. *Joints*; 2014.

994. Talamo, Giampaolo, Angtuaco, Edgardo, Walker, Ronald C., Dong, Li, Miceli, Marisa H., Zangari, Maurizio, Tricot, Guido, Barlogie, Bart, Anaissie, Elias. Avascular necrosis of femoral and/or humeral heads in multiple myeloma: results of a prospective study of patients treated with dexamethasone-based regimens and high-dose chemotherapy. *J Clin Oncology*; 2005.

995. Lee, Hyun Il, Shon, Min Soo, Koh, Kyoung Hwan, Lim, Tae Kang, Heo, Jaewon, Yoo, Jae Chul. Clinical and radiologic results of arthroscopic biceps tenodesis with suture anchor in the setting of rotator cuff tear. *Journal of Shoulder and Elbow Surgery*; 2014.

996. Codman, EA. Rupture of the supraspinatus tendon. *Clin Orthop Relat Res*; 1911.

997. Codman, EA. Complete rupture of the supraspinatus tendon. Operative treatment with report of two successful cases. *Boston Med Surg J*; 1911.

998. Codman, EA. Obscure lesions of the shoulder rupture of the supraspinatus tendon. *Boston Med Surg J*; 1927.

999. Wilson, C, Duff, G. Pathologic study of degeneration and rupture of the supraspinatus tendon. *Archives of Surgery*; 1943.

1000. Olsson, O. Degenerative changes of the shoulder joint and their connection with shoulder pain; a morphological and clinical investigation with special attention to the cuff and biceps tendon. *Acta Chir Scand Suppl*; 1953.

1001. Keyes, EL. Observations on rupture of supraspinatus tendon. Based upon a study of 73 cadavers. *Ann Surg*; 1933.

1002. Keyes, EL. Anatomical observations on senile change in the shoulder. *J Bone Joint Surg*; 1935.

1003. Von Meyer, AW. Chronic functional lesions of the shoulder. *Arch Surg*; 1937.

1004. Skinner, H. Anatomical considerations relative to rupture of the supraspinatus tendon. *J Bone Joint Surg*; 1937.

1005. Cotton, R. E., Rideout, D. F. Tears of the Humeral Rotator Cuff; a Radiological and Pathological Necropsy Survey. *J Bone Joint Surg Br*; May 1964.

1006. Macnab, I. Rotator cuff tendinitis. *Ann R Coll Surg Engl*; Nov 1973.

1007. Schellingerhout, J. M., Verhagen, A. P., Thomas, S., Koes, B. W. Lack of uniformity in diagnostic labeling of shoulder pain: time for a different approach. *Man Ther*; Dec 2008.

1008. Neer, C. S.,2nd, Kirby, R. M. Revision of humeral head and total shoulder arthroplasties. *Clin Orthop Relat Res*; Oct 1982.

1009. Ishii, H., Brunet, J. A., Welsh, R. P., Uhthoff, H. K. “Bursal reaction” in rotator cuff tearing, the impingement syndrome, and calcifying tendinitis. *J Shoulder Elbow Surg*; 1997.

1010. Chard, M. D., Cawston, T. E., Riley, G. P., Gresham, G. A., Hazleman, B. L. Rotator cuff degeneration and lateral epicondylitis: a comparative histological study. *Ann Rheum Dis*; Jan 1994.

1011. Belling Sorensen, A. K., Jorgensen, U. Secondary impingement in the shoulder. An improved terminology in impingement. *Scand J Med Sci Sports*; Oct 2000.

1012. Itoi, E., Minagawa, H., Yamamoto, N., Seki, N., Abe, H. Are pain location and physical examinations useful in locating a tear site of the rotator cuff? *Am J Sports Med*; Feb 2006.

1013. Lindblom, K, Palmer, I. Ruptures of the tendon aponeurosis of the shoulder joint---the so-called supraspinatus ruptures. *Acta Chir Scand*; 1939.

1014. Rathbun, J. B., Macnab, I. The microvascular pattern of the rotator cuff. *J Bone Joint Surg Br*; Aug 1970.

1015. Moseley, H. F. The vascular supply of the rotator cuff. *Surg Clin North Am*; Dec 1963.

1016. Rothman, R. H., Parke, W. W. The vascular anatomy of the rotator cuff. *Clin Orthop Relat Res*; Jul-Aug 1965.

1017. Chansky, H. A., Iannotti, J. P. The vascularity of the rotator cuff. *Clin Sports Med*; Oct 1991.

1018. Brooks, C. H., Revell, W. J., Heatley, F. W. A quantitative histological study of the vascularity of the rotator cuff tendon. *J Bone Joint Surg Br*; Jan 1992.

1019. Viikari-Juntura, EJ, Vuori, J, Silverstein, B, Kalimo, R, Kuosma, E, Videman, T. A life-long prospective study on the role of psychosocial factors in neck-shoulder and low back pain. *Spine*; 1991.

1020. Kaergaard, A., Andersen, J. H. Musculoskeletal disorders of the neck and shoulders in female sewing machine operators: prevalence, incidence, and prognosis. *Occup Environ Med*; Aug 2000.

1021. Meyer, AW. Further observation upon use-destruction in joints. *J Bone Joint Surg*; 1922.

1022. Meyer, AW. Furhter evidences of attrition in the human body. *Am J Anat*; 1924.

1023. Meyer, AW. Spontaneous dislocation of the tendon of the long head of the biceps brachii. *Arch Surg*; 1926.

1024. Neer, C. S.,2nd. Anterior acromioplasty for the chronic impingement syndrome in the shoulder: a preliminary report. *J Bone Joint Surg Am*; Jan 1972.

1025. Milgrom, C., Schaffler, M., Gilbert, S., van Holsbeeck, M. Rotator-cuff changes in asymptomatic adults. The effect of age, hand dominance and gender. *J Bone Joint Surg Br*; Mar 1995.

1026. Worland, RL, Lee, D, Orozco, CG, Soza-Rex, F, Keenan, J. Correlation of age, acromial morphology, and rotator cuff tear pathology diagnosed by ultrasound in asymptomatic patients. *J South Orthop Assoc*; 2003.

1027. Zuckerman, JD, Cuomo, F., Rokito, S. Definition and classification of frozen shoulder: a consensus approach. *J Shoulder Elbow Surg*; 1994.

1028. Bigliani, L. U., Ticker, J. B., Flatow, E. L., Soslowsky, L. J., Mow, V. C. The relationship of acromial architecture to rotator cuff disease. *Clin Sports Med*; Oct 1991.

1029. Katthagen, J Christoph, Vap, Alexander R, Tahal, Dimitri S, Horan, Marilee P, Millett, Peter J. Arthroscopic repair of isolated partial-and full-thickness upper third subscapularis tendon tears: Minimum 2-year outcomes after single-anchor repair and biceps tenodesis. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2017.

1030. Needell, SD, Zlatkin, MB, Sher, JS, Murphy, BJ, Uribe, JW. MR imaging of the rotator cuff: peritendinous and bone abnormalities in an asymptomatic population. *Am J Roentgenol*; 1996.

1031. Reilly, P, MacLeod, I, MacFarland, R, Windley, J, Emery, RJH. Dead men and radiologists don’t lie: a review of cadaveric and radiological studies of rotator cuff tear prevalance. *Ann Royal College of Surg Engl*; 2006.

1032. Lewis, J. S. Rotator cuff tendinopathy/subacromial impingement syndrome: is it time for a new method of assessment? *Br J Sports Med*; Apr 2009.

1033. Sher, JS, Uribe, JW, Posada, A, Murphy, BJ, Zlatkin, MB. Abnormal findings on magnetic resonance images of asymptomatic shoulders. *J Bone Joint Surg Am*; 1995.

1034. Yamamoto, N., Muraki, T., Sperling, J. W., Steinmann, S. P., Itoi, E., Cofield, R. H., An, K. N. Impingement mechanisms of the Neer and Hawkins signs. *J Shoulder Elbow Surg*; Nov-Dec 2009.

1035. Yamamoto, A., Takagishi, K., Osawa, T., Yanagawa, T., Nakajima, D., Shitara, H., Kobayashi, T. Prevalence and risk factors of a rotator cuff tear in the general population. *J Shoulder Elbow Surg*; Jan 2010.

1036. Tempelhof, S, Rupp, S, Seil, R. Age-related prevalence of rotator cuff tears in asymptomatic shoulders. *J Shoulder Elbow Surg*; 1999.

1037. Schibany, N, Zehetgruber, H, Kainberger, F, Wurnig, C, Ba-Ssalamah, A, Herneth, AM, Lang, T, Gruber, D, Breitenseher, MJ. Rotator cuff tears in asymptomatic individuals: a clinical and ultrasonographic screening study. *Eur J Radiol*; 2004.

1038. Sakurai, G., Ozaki, J., Tomita, Y., Nakagawa, Y., Kondo, T., Tamai, S. Morphologic changes in long head of biceps brachii in rotator cuff dysfunction. *J Orthop Sci*; 1998.

1039. Linsell, L., Dawson, J., Zondervan, K., Rose, P., Randall, T., Fitzpatrick, R., Carr, A. Prevalence and incidence of adults consulting for shoulder conditions in UK primary care; patterns of diagnosis and referral. *Rheumatology (Oxford)*; Feb 2006.

1040. Cassou, B., Derriennic, F., Monfort, C., Norton, J., Touranchet, A. Chronic neck and shoulder pain, age, and working conditions: longitudinal results from a large random sample in France. *Occup Environ Med*; Aug 2002.

1041. Roquelaure, Y., Ha, C., Leclerc, A., Touranchet, A., Sauteron, M., Melchior, M., Imbernon, E., Goldberg, M. Epidemiologic surveillance of upper-extremity musculoskeletal disorders in the working population. *Arthritis Rheum*; Oct 15 2006.

1042. Clayton, R. A., Court-Brown, C. M. The epidemiology of musculoskeletal tendinous and ligamentous injuries. *Injury*; Dec 2008.

1043. Yamaguchi, K., Ditsios, K., Middleton, W. D., Hildebolt, C. F., Galatz, L. M., Teefey, S. A. The demographic and morphological features of rotator cuff disease. A comparison of asymptomatic and symptomatic shoulders. *J Bone Joint Surg Am*; Aug 2006.

1044. Moosmayer, S., Smith, H. J., Tariq, R., Larmo, A. Prevalence and characteristics of asymptomatic tears of the rotator cuff: an ultrasonographic and clinical study. *J Bone Joint Surg Br*; Feb 2009.

1045. Miniaci, A., Dowdy, P. A., Willits, K. R., Vellet, A. D. Magnetic resonance imaging evaluation of the rotator cuff tendons in the asymptomatic shoulder. *Am J Sports Med*; Mar-Apr 1995.

1046. Travell, J. G,D. G Simons,and L. S Simons. Myofascial Pain And Dysfunction. 1999.

1047. Dickson, J. A., Crosby, E. H.. Periarthritis of the shoulder-an analysis of 200 cases. *J Amner Med. Assoc*; 1932.

1048. Lippmann, RK. Frozen shoulder; periarthritis; bicipital tenosynovitis. *Arch Surg*; 1943.

1049. Kuye, Ifedayo O., Jain, Nitin B., Warner, Lauren, Herndon, James H., Warner, Jon J. P. Economic evaluations in shoulder pathologies: a systematic review of the literature. *Journal of shoulder and elbow surgery*; 2012.

1050. Greving, K., Dorrestijn, O., Winters, J. C., Groenhof, F., van der Meer, K., Stevens, M., Diercks, R. L. Incidence, prevalence, and consultation rates of shoulder complaints in general practice. *Scand J Rheumatol*; Mar 2012.

1051. Adamson, J., Ebrahim, S., Dieppe, P., Hunt, K. Prevalence and risk factors for joint pain among men and women in the West of Scotland Twenty-07 study. *Ann Rheum Dis*; Apr 2006.

1052. Urwin, M., Symmons, D., Allison, T., Brammah, T., Busby, H., Roxby, M., Simmons, A., Williams, G. Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites, and the relation to social deprivation. *Ann Rheum Dis*; Nov 1998.

1053. Chard, M. D., Hazleman, R., Hazleman, B. L., King, R. H., Reiss, B. B. Shoulder disorders in the elderly: a community survey. *Arthritis Rheum*; Jun 1991.

1054. Bongers, P. M. The cost of shoulder pain at work. *Bmj*; Jan 13 2001.

1055. Speed, C. A. Fortnightly review: Corticosteroid injections in tendon lesions. *Br Med J*; Aug 18 2001.

1056. Silverstein, B., Viikari-Juntura, E., Kalat, J. Use of a prevention index to identify industries at high risk for work-related musculoskeletal disorders of the neck, back, and upper extremity in Washington state, 1990-1998. *Am J Ind Med*; Mar 2002.

1057. Punnett, L. The costs of work-related musculoskeletal disorders in automotive manufacturing. *New Solut*; 1999.

1058. Waehrer, G., Leigh, J. P., Miller, T. R. Costs of occupational injury and illness within the health services sector. *Int J Health Serv*; 2005.

1059. Brown, N. D., Thomas, N. I. Exploring variables among medical center employees with injuries: developing interventions and strategies. *Aaohn J*; Nov 2003.

1060. Meislin, R. J., Sperling, J. W., Stitik, T. P. Persistent shoulder pain: epidemiology, pathophysiology, and diagnosis. *Am J Orthop (Belle Mead NJ)*; Dec 2005.

1061. Council, N.S. Worker's Compensation Costs. 2019.

1062. Hughes, R. E., Silverstein, B. A., Evanoff, B. A. Risk factors for work-related musculoskeletal disorders in an aluminum smelter. *Am J Ind Med*; Jul 1997.

1063. Rhode, BA, Rhode, WS. IRetrospective comparison of a novel-triple row to modified mason allen rotator cuff repair in a worker's comp population MOJ Orthop Rheumatol. 2015; 3 (1): 252–256.

1064. Viola, R. W., Boatright, K. C., Smith, K. L., Sidles, J. A., Matsen, F. A.,3rd. Do shoulder patients insured by workers' compensation present with worse self-assessed function and health status? *J Shoulder Elbow Surg*; Sep-Oct 2000.

1065. Holtby, R., Razmjou, H. Impact of work-related compensation claims on surgical outcome of patients with rotator cuff related pathologies: a matched case-control study. *J Shoulder Elbow Surg*; Apr 2010.

1066. Frieman, B.G. and J.M. Fenlin,Jr. Anterior acromioplasty: effect of litigation and workers' compensation. *J Shoulder Elbow Surg*; 1995.

1067. Misamore, G. W., Ziegler, D. W., Rushton, J. L.,2nd. Repair of the rotator cuff. A comparison of results in two populations of patients. *J Bone Joint Surg Am*; Sep 1995.

1068. Koljonen, P., Chong, C., Yip, D. Difference in outcome of shoulder surgery between workers' compensation and nonworkers' compensation populations. *Int Orthop*; Apr 2009.

1069. Smith, K. L., Harryman, D. T.,2nd, Antoniou, J., Campbell, B., Sidles, J. A., Matsen, F. A.,3rd. A prospective, multipractice study of shoulder function and health status in patients with documented rotator cuff tears. *J Shoulder Elbow Surg*; Sep-Oct 2000.

1070. Henn, R.F.,3rd,et al. Patients with workers' compensation claims have worse outcomes after rotator cuff repair. *J Bone Joint Surg Am*; 2008.

1071. Croft, P., Pope, D., Silman, A. The clinical course of shoulder pain: prospective cohort study in primary care. Primary Care Rheumatology Society Shoulder Study Group. *Bmj*; Sep 7 1996.

1072. van der Windt, D. A., van der Heijden, G. J., van den Berg, S. G., ter Riet, G., de Winter, A. F., Bouter, L. M. Ultrasound therapy for musculoskeletal disorders: a systematic review. *Pain*; Jun 1999.

1073. Winters, J. C., Sobel, J. S., Groenier, K. H., Arendzen, J. H., Meyboom-De Jong, B. A shoulder pain score: a comprehensive questionnaire for assessing pain in patients with shoulder complaints. *Scand J Rehabil Med*; Sep 1996.

1074. Winters, J. C., Jorritsma, W., Groenier, K. H., Sobel, J. S., Meyboom-de Jong, B., Arendzen, H. J. Treatment of shoulder complaints in general practice: long term results of a randomised, single blind study comparing physiotherapy, manipulation, and corticosteroid injection. *Bmj*; May 22 1999.

1075. Macfarlane, G. J., Hunt, I. M., Silman, A. J. Predictors of chronic shoulder pain: a population based prospective study. *J Rheumatol*; Aug 1998.

1076. Gartsman, G.M.,et al. Self-assessment of general health status in patients with five common shoulder conditions. *J Shoulder Elbow Surg*; 1998.

1077. Largacha, M., Parsons, I. M. th, Campbell, B., Titelman, R. M., Smith, K. L., Matsen, F.,3rd. Deficits in shoulder function and general health associated with sixteen common shoulder diagnoses: a study of 2674 patients. *J Shoulder Elbow Surg*; Jan-Feb 2006.

1078. Harryman, D.T.,2nd,et al. A prospective multipractice investigation of patients with full-thickness rotator cuff tears: the importance of comorbidities, practice, and other covariables on self-assessed shoulder function and health status. *J Bone Joint Surg Am*; 2003.

1079. Silverstein, B. A., Viikari-Juntura, E., Fan, Z. J., Bonauto, D. K., Bao, S., Smith, C. Natural course of nontraumatic rotator cuff tendinitis and shoulder symptoms in a working population. *Scand J Work Environ Health*; Apr 2006.

1080. Green, S., Buchbinder, R., Glazier, R., Forbes, A. Systematic review of randomised controlled trials of interventions for painful shoulder: selection criteria, outcome assessment, and efficacy. *Bmj*; Jan 31 1998.

1081. McClure, P., Tate, A. R., Kareha, S., Irwin, D., Zlupko, E. A clinical method for identifying scapular dyskinesis, part 1: reliability. *J Athl Train*; Mar-Apr 2009.

1082. Uhl, TL, Kibler, WB, Gecewich, B,et al. Evaluation of clinical assessment methods for scapular dyskinesis. *Arthroscopy*; 2009.

1083. Munro, W., Healy, R. The validity and accuracy of clinical tests used to detect labral pathology of the shoulder--a systematic review. *Man Ther*; Apr 2009.

1084. Hughes, P. C., Taylor, N. F., Green, R. A. Most clinical tests cannot accurately diagnose rotator cuff pathology: a systematic review. *Aust J Physiother*; 2008.

1085. Park, H. B., Yokota, A., Gill, H. S., El Rassi, G., McFarland, E. G. Diagnostic accuracy of clinical tests for the different degrees of subacromial impingement syndrome. *J Bone Joint Surg Am*; Jul 2005.

1086. Silva, L., Andreu, J. L., Munoz, P., Pastrana, M., Millan, I., Sanz, J., Barbadillo, C., Fernandez-Castro, M. Accuracy of physical examination in subacromial impingement syndrome. *Rheumatology (Oxford)*; May 2008.

1087. Hanchard, N. C., Lenza, M., Handoll, H. H., Takwoingi, Y. Physical tests for shoulder impingements and local lesions of bursa, tendon or labrum that may accompany impingement. *Cochrane Database Syst Rev*; 2013.

1088. Farber, A. J., Castillo, R., Clough, M., Bahk, M., McFarland, E. G. Clinical assessment of three common tests for traumatic anterior shoulder instability. *J Bone Joint Surg Am*; Jul 2006.

1089. Lo, I. K., Nonweiler, B., Woolfrey, M., Litchfield, R., Kirkley, A. An evaluation of the apprehension, relocation, and surprise tests for anterior shoulder instability. *Am J Sports Med*; Mar 2004.

1090. Gerber, C., Ganz, R. Clinical assessment of instability of the shoulder. With special reference to anterior and posterior drawer tests. *J Bone Joint Surg Br*; Aug 1984.

1091. Gross, M. L., Distefano, M. C. Anterior release test. A new test for occult shoulder instability. *Clin Orthop Relat Res*; Jun 1997.

1092. Nakagawa, S., Yoneda, M., Hayashida, K., Obata, M., Fukushima, S., Miyazaki, Y. Forced shoulder abduction and elbow flexion test: a new simple clinical test to detect superior labral injury in the throwing shoulder. *Arthroscopy*; Nov 2005.

1093. Speer, KP, Hannafin, JA, Altchek, DW, Warren, RF. An evaluation of the shoulder relocation test. *Am J Sports Med*; 1994.

1094. Mackinnon, S. E., Novak, C. B. Thoracic outlet syndrome. *Curr Probl Surg*; Nov 2002.

1095. O'Brien, S. J., Pagnani, M. J., Fealy, S., McGlynn, S. R., Wilson, J. B. The active compression test: a new and effective test for diagnosing labral tears and acromioclavicular joint abnormality. *Am J Sports Med*; Sep-Oct 1998.

1096. Chronopoulos, E.,et al. Diagnostic value of physical tests for isolated chronic acromioclavicular lesions. *Am J Sports Med*; 2004.

1097. Calis, M.,et al. Diagnostic values of clinical diagnostic tests in subacromial impingement syndrome. *Arch Phys Med Rehabil*; 2000.

1098. Michener, L. A., Walsworth, M. K., Doukas, W. C., Murphy, K. P. Reliability and diagnostic accuracy of 5 physical examination tests and combination of tests for subacromial impingement. *Arch Phys Med Rehabil*; Nov 2009.

1099. McGee, S. Examination of the musculoskeletal system: the shoulder. *Evidence-based Physical Diagnosis, 2nd Edtion*; 2007.

1100. Zaslav, K. R. Internal rotation resistance strength test: a new diagnostic test to differentiate intra-articular pathology from outlet (Neer) impingement syndrome in the shoulder. *J Shoulder Elbow Surg*; Jan-Feb 2001.

1101. Murrell, G. A., Walton, J. R. Diagnosis of rotator cuff tears. *Lancet*; Mar 10 2001.

1102. Hertel, R.,et al. Lag signs in the diagnosis of rotator cuff rupture. *J Shoulder Elbow Surg*; 1996.

1103. MacDonald, P. B., Clark, P., Sutherland, K. An analysis of the diagnostic accuracy of the Hawkins and Neer subacromial impingement signs. *J Shoulder Elbow Surg*; Jul-Aug 2000.

1104. Parentis, M. A., Glousman, R. E., Mohr, K. S., Yocum, L. A. An evaluation of the provocative tests for superior labral anterior posterior lesions. *Am J Sports Med*; Feb 2006.

1105. Boileau, P., Ahrens, P. M., Hatzidakis, A. M. Entrapment of the long head of the biceps tendon: the hourglass biceps--a cause of pain and locking of the shoulder. *J Shoulder Elbow Surg*; May-Jun 2004.

1106. Litaker, D., Pioro, M., El Bilbeisi, H., Brems, J. Returning to the bedside: using the history and physical examination to identify rotator cuff tears. *J Am Geriatr Soc*; Dec 2000.

1107. Itoi, E., Kido, T., Sano, A., Urayama, M., Sato, K. Which is more useful, the "full can test" or the "empty can test," in detecting the torn supraspinatus tendon? *Am J Sports Med*; Jan-Feb 1999.

1108. Leroux, J. L., Thomas, E., Bonnel, F., Blotman, F. Diagnostic value of clinical tests for shoulder impingement syndrome. *Rev Rhum Engl Ed*; Jun 1995.

1109. Codman, EA. The shoulder: rupture of the supraspinatus tendon and other lesions in or about the subacromial bursa. *Miller & Medical*; 1934.

1110. Wolf, E. M., Agrawal, V. Transdeltoid palpation (the rent test) in the diagnosis of rotator cuff tears. *J Shoulder Elbow Surg*; Sep-Oct 2001.

1111. Lyons, A. R., Tomlinson, J. E. Clinical diagnosis of tears of the rotator cuff. *J Bone Joint Surg Br*; May 1992.

1112. Scheibel, M, Magosch, P, Pritsch, M, Lichtenberg, S, Habermeyer, P. The belly-off sign: a new clinical diagnostic sign for subscapularis lesions. *Arthroscopy*; 2005.

1113. Miller, C. A., Forrester, G. A., Lewis, J. S. The validity of the lag signs in diagnosing full-thickness tears of the rotator cuff: a preliminary investigation. *Arch Phys Med Rehabil*; Jun 2008.

1114. Barth, J. R., Burkhart, S. S., De Beer, J. F. The bear-hug test: a new and sensitive test for diagnosing a subscapularis tear. *Arthroscopy*; Oct 2006.

1115. Gill, H. S., El Rassi, G., Bahk, M. S., Castillo, R. C., McFarland, E. G. Physical examination for partial tears of the biceps tendon. *Am J Sports Med*; Aug 2007.

1116. Gerber, C., Krushell, R. J. Isolated rupture of the tendon of the subscapularis muscle. Clinical features in 16 cases. *J Bone Joint Surg Br*; May 1991.

1117. Tokish, JM, Decker, MJ, Ellis, HB, Torry, MR, Hawkins, RJ. The belly-press test for the physical examination of hte subscapularis muscle: electromyographic validation and comparison to the lift-off test. *J Shoulder Elbow Surg*; 2003.

1118. Walch, G., Boulahia, A., Calderone, S., Robinson, A. H. The 'dropping' and 'hornblower's' signs in evaluation of rotator-cuff tears. *J Bone Joint Surg Br*; Jul 1998.

1119. Castoldi, F., Blonna, D., Hertel, R. External rotation lag sign revisited: accuracy for diagnosis of full thickness supraspinatus tear. *J Shoulder Elbow Surg*; Jul-Aug 2009.

1120. Heyworth, B.E. and R.J. Williams. Internal impingement of the shoulder. *Am J Sports Med*; 2009.

1121. Meister, K., Buckley, B., Batts, J. The posterior impingement sign: diagnosis of rotator cuff and posterior labral tears secondary to internal impingement in overhand athletes. *Am J Orthop (Belle Mead NJ)*; Aug 2004.

1122. Guanche, CA, Jones, DC. Clinical testing for tears of the glenoid labrum. *Arthroscopy*; 2003.

1123. Morgan, C. D., Burkhart, S. S., Palmeri, M., Gillespie, M. Type II SLAP lesions: three subtypes and their relationships to superior instability and rotator cuff tears. *Arthroscopy*; Sep 1998.

1124. Tong, H. C., Haig, A. J., Yamakawa, K. The Spurling test and cervical radiculopathy. *Spine (Phila Pa 1976)*; Jan 15 2002.

1125. Woodward, T. W., Best, T. M. The painful shoulder: part I. Clinical evaluation. *Am Fam Physician*; May 15 2000.

1126. Kim, Yang-Soo, Kim, Jung-Man, Ha, Kee-Yong, Choy, Soon, Joo, Min-Wook, Chung, Yang-Guk. The Passive Compression Test. *Am J Sports Med*; Sep 2007.

1127. Jia, X., Ji, J. H., Petersen, S. A., Keefer, J., McFarland, E. G. Clinical evaluation of the shoulder shrug sign. *Clin Orthop Relat Res*; Nov 2008.

1128. American Medical Association Council on Ethical and Judicial Affairs, . Code of Medical Ethics: Current Opinions with Annotations, 2002-2003 edition. 2002.

1129. Harkness, E. F., Macfarlane, G. J., Nahit, E. S., Silman, A. J., McBeth, J. Mechanical and psychosocial factors predict new onset shoulder pain: a prospective cohort study of newly employed workers. *Occup Environ Med*; Nov 2003.

1130. Andersen, J. H., Gaardboe, O. Musculoskeletal disorders of the neck and upper limb among sewing machine operators: a clinical investigation. *Am J Ind Med*; Dec 1993.

1131. Andersen, J. H., Kaergaard, A., Mikkelsen, S., Jensen, U. F., Frost, P., Bonde, J. P., Fallentin, N., Thomsen, J. F. Risk factors in the onset of neck/shoulder pain in a prospective study of workers in industrial and service companies. *Occup Environ Med*; Sep 2003.

1132. Bernard, B., Sauter, S., Fine, L., Petersen, M., Hales, T. Job task and psychosocial risk factors for work-related musculoskeletal disorders among newspaper employees. *Scand J Work Environ Health*; Dec 1994.

1133. Burdorf, A. and A. Monster. Exposure to vibration and self-reported health complaints of riveters in the aircraft industry. *Ann Occup Hyg*; 1991.

1134. Chiang, H.C.,et al. Prevalence of shoulder and upper-limb disorders among workers in the fish-processing industry. *Scand J Work Environ Health*; 1993.

1135. Flodmark, B. T., Aase, G. Musculoskeletal symptoms and type A behaviour in blue collar workers. *Br J Ind Med*; Oct 1992.

1136. Hales, TR, Habes, D, Fine, L, et al. Hazard Evaluation and Technical Assistance Report: John Morrell and Co., Sioux Falls, SD. 1989.

1137. Hoekstra, EJ, Hurrell, JJ, Swanson, NG. Hazard Evaluation and Technical Assistance Report: Social Security Administration Teleservice Centers, Boston, MA; Fort Lauderdale, FL. 1994.

1138. Ignatius, Y. T., Yee, T. Y., Yan, L. T. Self reported musculoskeletal problems amongst typist and possible risk factors. *J Hum Ergol (Tokyo)*; Dec 1993.

1139. Jonsson, B. Electromyographic studies of job rotation. *Scand J Work Environ Health*; 1988.

1140. Kiken, S, Stringer, W, Fine, L, Sinks, L, Tanaka, S. Health Hazard Evaluation Report No. HETA-89-307-2009, Perdue Farms, Inc., Lewiston, North Carolina, Robersonville, North Carolina. 1990.

1141. Kilbom, A, Persson, J, Jonsson, B. Risk factors for work-related disorders of the neck and shoulder with special emphasis on working postures and movements. *The Ergonomics of Working Postures*; 1986.

1142. Kvarnstrom, S. Occurrence of musculoskeletal, disorders in a manufacturing industry with special attention to occupational shoulder disorders. *Scand J Rehabil Med Suppl*; 1983.

1143. Magnusson, M. L., Pope, M. H., Wilder, D. G., Areskoug, B. Are occupational drivers at an increased risk for developing musculoskeletal disorders? *Spine (Phila Pa 1976)*; Mar 15 1996.

1144. Milerad, E., Ekenvall, L. Symptoms of the neck and upper extremities in dentists. *Scand J Work Environ Health*; Apr 1990.

1145. Ohara, H., Aoyama, H., Itani, T. Health hazard among cash register operators and the effect of improved working conditions. *J Hum Ergol (Tokyo)*; Sep 1976.

1146. Ohlsson, K., Attewell, R., Skerfving, S. Self-reported symptoms in the neck and upper limbs of female assembly workers. Impact of length of employment, work pace, and selection. *Scand J Work Environ Health*; Feb 1989.

1147. Onishi, N., Nomura, H., Sakai, K., Yamamoto, T., Hirayama, K., Itani, T. Shoulder muscle tenderness and physical features of female industrial workers. *J Hum Ergol (Tokyo)*; Dec 1976.

1148. Ostergren, P. O., Hanson, B. S., Balogh, I., Ektor-Andersen, J., Isacsson, A., Orbaek, P., Winkel, J., Isacsson, S. O. Incidence of shoulder and neck pain in a working population: effect modification between mechanical and psychosocial exposures at work? Results from a one year follow up of the Malmo shoulder and neck study cohort. *J Epidemiol Community Health*; Sep 2005.

1149. Picavet, H. S., Schouten, J. S. Musculoskeletal pain in the Netherlands: prevalences, consequences and risk groups, the DMC(3)-study. *Pain*; Mar 2003.

1150. Punnett, L., Robins, J. M., Wegman, D. H., Keyserling, W. M. Soft tissue disorders in the upper limbs of female garment workers. *Scand J Work Environ Health*; Dec 1985.

1151. Rossignol, A. M., Morse, E. P., Summers, V. M., Pagnotto, L. D. Video display terminal use and reported health symptoms among Massachusetts clerical workers. *J Occup Med*; Feb 1987.

1152. Sakakibara, H., Miyao, M., Kondo, T., Yamada, S., Nakagawa, T., Kobayashi, F. Relation between overhead work and complaints of pear and apple orchard workers. *Ergonomics*; May 1987.

1153. Sakakibara, H., Miyao, M., Kondo, T., Yamada, S. Overhead work and shoulder-neck pain in orchard farmers harvesting pears and apples. *Ergonomics*; Apr 1995.

1154. Schibye, B., Skov, T., Ekner, D., Christiansen, J. U., Sjogaard, G. Musculoskeletal symptoms among sewing machine operators. *Scand J Work Environ Health*; Dec 1995.

1155. Partridge, R. E., Duthie, J. J. Rheumatism in dockers and civil servants. A comparison of heavy manual and sedentary workers. *Ann Rheum Dis*; Nov 1968.

1156. Ekberg, K.,et al. Cross-sectional study of risk factors for symptoms in the neck and shoulder area. *Ergonomics*; 1995.

1157. Sweeney, MH, Petersen, M, O'Neill, V. Hazard Evaluation and Technical Assistance Report: Registry of Interpreters for the Deaf,

Ohio Chapter. 1994.

1158. Wells, J. A., Zipp, J. F., Schuette, P. T., McEleney, J. Musculoskeletal disorders among letter carriers. A comparison of weight carrying, walking & sedentary occupations. *J Occup Med*; Nov 1983.

1159. Hallman, D. M., Holtermann, A., Dencker-Larsen, S., Birk Jorgensen, M., Norregaard Rasmussen, C. D. Are trajectories of neck-shoulder pain associated with sick leave and work ability in workers? A 1-year prospective study. *BMJ Open*; Mar 20 2019.

1160. Coenen, P., Douwes, M., van den Heuvel, S., Bosch, T. Towards exposure limits for working postures and musculoskeletal symptoms - a prospective cohort study. *Ergonomics*; Sep 2016.

1161. Feleus, A., Miedema, H. S., Bierma-Zeinstra, S. M., Hoekstra, T., Koes, B. W., Burdorf, A. Sick leave in workers with arm, neck and/or shoulder complaints; defining occurrence and discriminative trajectories over a 2-year time period. *Occup Environ Med*; Feb 2017.

1162. Fanavoll, R., Nilsen, T. I., Holtermann, A., Mork, P. J. Psychosocial work stress, leisure time physical exercise and the risk of chronic pain in the neck/shoulders: Longitudinal data from the Norwegian HUNT Study. *Int J Occup Med Environ Health*; 2016.

1163. Sawada, T., Matsudaira, K., Muto, Y., Koga, T., Takahashi, M. Potential risk factors for onset of severe neck and shoulder discomfort (Katakori) in urban Japanese workers. *Ind Health*; Jun 10 2016.

1164. Hallman, D. M., Gupta, N., Mathiassen, S. E., Holtermann, A. Association between objectively measured sitting time and neck-shoulder pain among blue-collar workers. *Int Arch Occup Environ Health*; Nov 2015.

1165. Hanvold, T. N., Waersted, M., Mengshoel, A. M., Bjertness, E., Twisk, J., Veiersted, K. B. A longitudinal study on risk factors for neck and shoulder pain among young adults in the transition from technical school to working life. *Scand J Work Environ Health*; Nov 2014.

1166. Aaras, A. The impact of ergonomic intervention on individual health and corporate prosperity in a telecommunications environment. *Ergonomics*; 1994.

1167. Alipour, A., Ghaffari, M., Shariati, B., Jensen, I., Vingard, E. Four-year incidence of sick leave because of neck and shoulder pain and its association with work and lifestyle. *Spine (Phila Pa 1976)*; Feb 15 2009.

1168. Andersen, J. H., Gaardboe, O. Prevalence of persistent neck and upper limb pain in a historical cohort of sewing machine operators. *Am J Ind Med*; Dec 1993.

1169. Andersen, Johan Hviid, Kaergaard, Anette, Frost, Poul, Thomsen, Jane Frølund, Bonde, Jens Peter, Fallentin, Nils, Borg, Vilhelm, Mikkelsen, Sigurd. Physical, psychosocial, and individual risk factors for neck/shoulder pain with pressure tenderness in the muscles among workers performing monotonous, repetitive work. *Spine*; 2002.

1170. Bergqvist, U., Wolgast, E., Nilsson, B., Voss, M. Musculoskeletal disorders among visual display terminal workers: individual, ergonomic, and work organizational factors. *Ergonomics*; Apr 1995.

1171. Bergqvist, U., Wolgast, E., Nilsson, B., Voss, M. The influence of VDT work on musculoskeletal disorders. *Ergonomics*; Apr 1995.

1172. Bjelle, A., Hagberg, M., Michaelson, G. Occupational and individual factors in acute shoulder-neck disorders among industrial workers. *Br J Ind Med*; Nov 1981.

1173. Blader, S., Barck-Holst, U., Danielsson, S., Ferhm, E., Kalpamaa, M., Leijon, M., Lindh, M., Markhede, G. Neck and shoulder complaints among sewing-machine operators: a study concerning frequency, symptomatology and dysfunction. *Appl Ergon*; Aug 1991.

1174. Brandt, K. E., Mackinnon, S. E. A technique for maximizing biceps recovery in brachial plexus reconstruction. *J Hand Surg Am*; Jul 1993.

1175. Ekberg, K., Bjorkqvist, B., Malm, P., Bjerre-Kiely, B., Karlsson, M., Axelson, O. Case-control study of risk factors for disease in the neck and shoulder area. *Occup Environ Med*; Apr 1994.

1176. Eltayeb, S., Staal, J. B., Hassan, A., de Bie, R. A. Work related risk factors for neck, shoulder and arms complaints: a cohort study among Dutch computer office workers. *J Occup Rehabil*; Dec 2009.

1177. Feveile, H., Jensen, C., Burr, H. Risk factors for neck-shoulder and wrist-hand symptoms in a 5-year follow-up study of 3,990 employees in Denmark. *Int Arch Occup Environ Health*; Apr 2002.

1178. Fredriksson, K., Alfredsson, L., Thorbjornsson, C. B., Punnett, L., Toomingas, A., Torgen, M., Kilbom, A. Risk factors for neck and shoulder disorders: a nested case-control study covering a 24-year period. *Am J Ind Med*; Nov 2000.

1179. Ghaffari, M., Alipour, A., Farshad, A. A., Yensen, I., Vingard, E. Incidence and recurrence of disabling low back pain and neck-shoulder pain. *Spine (Phila Pa 1976)*; Oct 1 2006.

1180. Grooten, W. J., Mulder, M., Josephson, M., Alfredsson, L., Wiktorin, C. The influence of work-related exposures on the prognosis of neck/shoulder pain. *Eur Spine J*; Dec 2007.

1181. Hagberg, M., Wegman, D. H. Prevalence rates and odds ratios of shoulder-neck diseases in different occupational groups. *Br J Ind Med*; Sep 1987.

1182. Holmstrom, E. B., Lindell, J., Moritz, U. Low back and neck/shoulder pain in construction workers: occupational workload and psychosocial risk factors. Part 1: Relationship to low back pain. *Spine (Phila Pa 1976)*; Jun 1992.

1183. Hooftman, W. E., van der Beek, A. J., Bongers, P. M., van Mechelen, W. Is there a gender difference in the effect of work-related physical and psychosocial risk factors on musculoskeletal symptoms and related sickness absence? *Scand J Work Environ Health*; Mar 2009.

1184. Hunting, W., Laubli, T., Grandjean, E. Postural and visual loads at VDT workplaces. I. Constrained postures. *Ergonomics*; Dec 1981.

1185. Kilbom, A., Persson, J. Work technique and its consequences for musculoskeletal disorders. *Ergonomics*; Feb 1987.

1186. Lapointe, J., Dionne, C. E., Brisson, C., Montreuil, S. Interaction between postural risk factors and job strain on self-reported musculoskeletal symptoms among users of video display units: a three-year prospective study. *Scand J Work Environ Health*; Mar 2009.

1187. Linton, S. J., Kamwendo, K. Risk factors in the psychosocial work environment for neck and shoulder pain in secretaries. *J Occup Med*; Jul 1989.

1188. Nyman, T., Mulder, M., Iliadou, A., Svartengren, M., Wiktorin, C. Physical workload, low back pain and neck-shoulder pain: a Swedish twin study. *Occup Environ Med*; Jun 2009.

1189. Ohlsson, K., Attewell, R. G., Palsson, B., Karlsson, B., Balogh, I., Johnsson, B., Ahlm, A., Skerfving, S. Repetitive industrial work and neck and upper limb disorders in females. *Am J Ind Med*; May 1995.

1190. Punnett, L., Fine, L. J., Keyserling, W. M., Herrin, G. D., Chaffin, D. B. Back disorders and nonneutral trunk postures of automobile assembly workers. *Scand J Work Environ Health*; Oct 1991.

1191. Sadeghi-Azandaryani, M., Burklein, D., Ozimek, A., Geiger, C., Mendl, N., Steckmeier, B., Heyn, J. Thoracic outlet syndrome: do we have clinical tests as predictors for the outcome after surgery? *Eur J Med Res*; Sep 28 2009.

1192. Tola, S., Riihimaki, H., Videman, T., Viikari-Juntura, E., Hanninen, K. Neck and shoulder symptoms among men in machine operating, dynamic physical work and sedentary work. *Scand J Work Environ Health*; Oct 1988.

1193. Tornqvist, E. W., Hagberg, M., Hagman, M., Risberg, E. H., Toomingas, A. The influence of working conditions and individual factors on the incidence of neck and upper limb symptoms among professional computer users. *Int Arch Occup Environ Health*; May 2009.

1194. van den Heuvel, S. G., van der Beek, A. J., Blatter, B. M., Bongers, P. M. Do work-related physical factors predict neck and upper limb symptoms in office workers? *Int Arch Occup Environ Health*; Aug 2006.

1195. Vihma, T., Nurminen, M., Mutanen, P. Sewing-machine operators' work and musculo-skeletal complaints. *Ergonomics*; Apr 1982.

1196. Charles, L. E., Ma, C. C., Burchfiel, C. M., Dong, R. G. Vibration and Ergonomic Exposures Associated With Musculoskeletal Disorders of the Shoulder and Neck. *Saf Health Work*; Jun 2018.

1197. Mather, L., Ropponen, A., Mittendorfer-Rutz, E., Narusyte, J., Svedberg, P. Health, work and demographic factors associated with a lower risk of work disability and unemployment in employees with lower back, neck and shoulder pain. *BMC Musculoskelet Disord*; Dec 26 2019.

1198. Nordander, C., Hansson, G. A., Ohlsson, K., Arvidsson, I., Balogh, I., Stromberg, U., Rittner, R., Skerfving, S. Exposure-response relationships for work-related neck and shoulder musculoskeletal disorders--Analyses of pooled uniform data sets. *Appl Ergon*; Jul 2016.

1199. Posch, M., Schranz, A., Lener, M., Senn, W., Ang, B. O., Burtscher, M., Ruedl, G. Prevalence and potential risk factors of flight-related neck, shoulder and low back pain among helicopter pilots and crewmembers: a questionnaire-based study. *BMC Musculoskelet Disord*; Jan 29 2019.

1200. van der Molen, H. F., Foresti, C., Daams, J. G., Frings-Dresen, M. H. W., Kuijer, Ppfm. Work-related risk factors for specific shoulder disorders: a systematic review and meta-analysis. *Occup Environ Med*; Oct 2017.

1201. Andersen, L. L., Fallentin, N., Thorsen, S. V., Holtermann, A. Physical workload and risk of long-term sickness absence in the general working population and among blue-collar workers: prospective cohort study with register follow-up. *Occup Environ Med*; Apr 2016.

1202. Miranda, H., Punnett, L., Viikari-Juntura, E., Heliovaara, M., Knekt, P. Physical work and chronic shoulder disorder. Results of a prospective population-based study. *Ann Rheum Dis*; Feb 2008.

1203. Bodin, Julie, Garlantézec, Ronan, Costet, Nathalie, Descatha, Alexis, Fouquet, Natacha, Caroly, Sandrine, Roquelaure, Yves. Forms of work organization and associations with shoulder disorders: results from a French working population. *Applied ergonomics*; 2017.

1204. Bernard, BP (Ed.). Musculoskeletal Disorders and Workplace Factors. A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back. 1997.

1205. Kuorinka, I, Forcier, L. Work-related Musculoskeletal Disorders (WMSDs): A Reference Book for Prevention. 1995.

1206. Welch, L. S., Hunting, K. L., Kellogg, J. Work-related musculoskeletal symptoms among sheet metal workers. *Am J Ind Med*; Jun 1995.

1207. Kamwendo, K., Linton, S. J., Moritz, U. Neck and shoulder disorders in medical secretaries. Part II. Ergonomical work environment and symptom profile. *Scand J Rehabil Med*; 1991.

1208. Trinkoff, A. M., Lipscomb, J. A., Geiger-Brown, J., Brady, B. Musculoskeletal problems of the neck, shoulder, and back and functional consequences in nurses. *Am J Ind Med*; Mar 2002.

1209. Roquelaure, Yves, Mariel, J, Fanello, S, Boissiere, JC, Chiron, H, Dano, C, Bureau, D, Penneau-Fontbonne, D. Active epidemiological surveillance of musculoskeletal disorders in a shoe factory. *Occupational and Environmental Medicine*; 2002.

1210. Frost, P. and J.H. Andersen. Shoulder impingement syndrome in relation to shoulder intensive work. *Occup Environ Med*; 1999.

1211. Moore, J. S., Garg, A. The Strain Index: a proposed method to analyze jobs for risk of distal upper extremity disorders. *Am Ind Hyg Assoc J*; May 1995.

1212. Moore, J. S., Rucker, N. P., Knox, K. Validity of generic risk factors and the strain index for predicting nontraumatic distal upper extremity morbidity. *Aihaj*; Mar-Apr 2001.

1213. Knox, K., Moore, J. S. Predictive validity of the Strain Index in turkey processing. *J Occup Environ Med*; May 2001.

1214. Hegmann, K.,et al. The Strain Index and Risk for Shoulder Disorders, Proceedings of the XVth Triennial Congress of the International Ergonomics Association. 2006.

1215. Silverstein, B., Fan, Z. J., Smith, C. K., Bao, S., Howard, N., Spielholz, P., Bonauto, D., Viikari-Juntura, E. Gender adjustment or stratification in discerning upper extremity musculoskeletal disorder risk? *Scand J Work Environ Health*; Mar 2009.

1216. Van Rijn, Rogier M, Huisstede, Bionka MA, Koes, Bart W, Burdorf, Alex. Associations between work-related factors and specific disorders of the shoulder—a systematic review of the literature. *Scandinavian journal of work, environment & health*; 2010.

1217. Herberts, P., Kadefors, R., Andersson, G., Petersen, I. Shoulder pain in industry: an epidemiological study on welders. *Acta Orthop Scand*; Jun 1981.

1218. Herberts, P., Kadefors, R., Hogfors, C., Sigholm, G. Shoulder pain and heavy manual labor. *Clin Orthop Relat Res*; Dec 1984.

1219. Herberts, P. and R. Kadefors. A study of painful shoulder in welders. *Acta Orthop Scand*; 1976.

1220. Bjelle, A, Hagberg, M, Michaelsson, G. Clinical and ergonomic factors in prolonged shoulder pain among industrial workers. *Scand J work and Health*; 1979.

1221. Silverstein, BA. The prevalence of upper extremity cumulative trauma disorders in industry [Dissertation]. 1985.

1222. Baron, S. Hazard evaluation and technical assistance report: Shoprite Supermarkets, New Jersey - New York. 1991.

1223. Kaerlev, L., Jensen, A., Nielsen, P. S., Olsen, J., Hannerz, H., Tuchsen, F. Hospital contacts for injuries and musculoskeletal diseases among seamen and fishermen: a population-based cohort study. *BMC Musculoskelet Disord*; 2008.

1224. Frost, P., Bonde, J. P., Mikkelsen, S., Andersen, J. H., Fallentin, N., Kaergaard, A., Thomsen, J. F. Risk of shoulder tendinitis in relation to shoulder loads in monotonous repetitive work. *Am J Ind Med*; Jan 2002.

1225. Zakaria, D. Rates of carpal tunnel syndrome, epicondylitis, and rotator cuff claims in Ontario workers during 1997. *Chronic Dis Can*; Spring 2004.

1226. Svendsen, Susanne Wulff, Dalbøge, Annett, Andersen, Johan Hviid, Thomsen, Jane Frølund, Frost, Poul. Risk of surgery for subacromial impingement syndrome in relation to neck-shoulder complaints and occupational biomechanical exposures: a longitudinal study. *Scandinavian journal of work, environment & health*; 2013.

1227. Shaikh, Afroz Z, Bhise, Swati A, Parab, Shilpa A. Prevalence of shoulder pain in petrol pump workers. *Journal of Applied and Advanced Research*; 2017.

1228. Melchior, M., Roquelaure, Y., Evanoff, B., Chastang, J. F., Ha, C., Imbernon, E., Goldberg, M., Leclerc, A. Why are manual workers at high risk of upper limb disorders? The role of physical work factors in a random sample of workers in France (the Pays de la Loire study). *Occup Environ Med*; Nov 2006.

1229. Roquelaure, Yves, Bodin, Julie, Ha, Catherine, Le Manac'h, Audrey Petit, Descatha, Alexis, Chastang, Jean-François, Leclerc, Annette, Goldberg, Marcel, Imbernon, Ellen. Personal, biomechanical, and psychosocial risk factors for rotator cuff syndrome in a working population. *Scandinavian journal of work, environment & health*; 2011.

1230. Luopajarvi, T., Kuorinka, I., Virolainen, M., Holmberg, M. Prevalence of tenosynovitis and other injuries of the upper extremities in repetitive work. *Scand J Work Environ Health*; 1979.

1231. McCormack, R. R.,Jr., Inman, R. D., Wells, A., Berntsen, C., Imbus, H. R. Prevalence of tendinitis and related disorders of the upper extremity in a manufacturing workforce. *J Rheumatol*; Jul 1990.

1232. Bergenudd, H., Lindgarde, F., Nilsson, B., Petersson, C. J. Shoulder pain in middle age. A study of prevalence and relation to occupational work load and psychosocial factors. *Clin Orthop Relat Res*; Jun 1988.

1233. Kukkonen, R. Prevention of fatigue amongst data entry operators. *Ergonomics of Workstation Design*; 1983.

1234. Thygesen, L. C., Mikkelsen, S., Pedersen, E. B., Moller, K. L., Alkjaer, T., Koblauch, H., Simonsen, E. B., Moller, S. P., Brauer, C. Subacromial shoulder disorders among baggage handlers: an observational cohort study. *Int Arch Occup Environ Health*; Jul 2016.

1235. Hanvold, T. N., Waersted, M., Mengshoel, A. M., Bjertness, E., Veiersted, K. B. Work with prolonged arm elevation as a risk factor for shoulder pain: a longitudinal study among young adults. *Appl Ergon*; Mar 2015.

1236. van Eijsden-Besseling, M. D., van den Bergh, K. A., Staal, J. B., de Bie, R. A., van den Heuvel, W. J. The course of nonspecific work-related upper limb disorders and the influence of demographic factors, psychologic factors, and physical fitness on clinical status and disability. *Arch Phys Med Rehabil*; Jun 2010.

1237. Macfarlane, G. J., Norrie, G., Atherton, K., Power, C., Jones, G. T. The influence of socioeconomic status on the reporting of regional and widespread musculoskeletal pain: results from the 1958 British Birth Cohort Study. *Ann Rheum Dis*; Oct 2009.

1238. Bodin, Julie, Garlantézec, Ronan, Costet, Nathalie, Descatha, Alexis, Viel, Jean-François, Roquelaure, Yves. Shoulder pain among male industrial workers: Validation of a conceptual model in two independent French working populations. *Applied Ergonomics*; 2020.

1239. Vargas-Prada, S. and D. Coggon. Psychological and psychosocial determinants of musculoskeletal pain and associated disability. *Best Pract Res Clin Rheumatol*; 2015.

1240. Sadeghian, F., Raei, M., Amiri, M. Persistent of Neck/Shoulder Pain among Computer Office Workers with Specific Attention to Pain Expectation, Somatization Tendency, and Beliefs. *Int J Prev Med*; Sep 2014.

1241. Johansson, J. A., Rubenowitz, S. Risk indicators in the psychosocial and physical work environment for work-related neck, shoulder and low back symptoms: a study among blue- and white-collar workers in eight companies. *Scand J Rehabil Med*; Sep 1994.

1242. van den Heuvel, S. G., Heinrich, J., Jans, M. P., van der Beek, A. J., Bongers, P. M. The effect of physical activity in leisure time on neck and upper limb symptoms. *Prev Med*; Jul 2005.

1243. Manninen, P., Heliovaara, M., Riihimaki, H., Makela, P. Does psychological distress predict disability? *Int J Epidemiol*; Oct 1997.

1244. Potter, M. Q., Wylie, J. D., Greis, P. E., Burks, R. T., Tashjian, R. Z. Psychological distress negatively affects self-assessment of shoulder function in patients with rotator cuff tears. *Clin Orthop Relat Res*; Dec 2014.

1245. Menendez, M. E., Baker, D. K., Oladeji, L. O., Fryberger, C. T., McGwin, G., Ponce, B. A. Psychological Distress Is Associated with Greater Perceived Disability and Pain in Patients Presenting to a Shoulder Clinic. *J Bone Joint Surg Am*; Dec 16 2015.

1246. Leroyer, A., Edme, J. L., Vaxevanoglou, X., Buisset, C., Laurent, P., Desobry, P., Frimat, P. Neck, shoulder, and hand and wrist pain among administrative employees: relation to work-time organization and psychosocial factors at work. *J Occup Environ Med*; Mar 2006.

1247. Roquelaure, Y., Ha, C., Rouillon, C., Fouquet, N., Leclerc, A., Descatha, A., Touranchet, A., Goldberg, M., Imbernon, E. Risk factors for upper-extremity musculoskeletal disorders in the working population. *Arthritis Rheum*; Oct 15 2009.

1248. Bodin, Julie, Ha, Catherine, Chastang, Jean-François, Descatha, Alexis, Leclerc, Annette, Goldberg, Marcel, Imbernon, Ellen, Roquelaure, Yves. Comparison of risk factors for shoulder pain and rotator cuff syndrome in the working population. *American journal of industrial medicine*; 2012.

1249. Grooten, Wilhelmus Johannes Andreas, Mulder, Marie, Josephson, Malin, Alfredsson, Lars, Wiktorin, Christina. The influence of work-related exposures on the prognosis of neck/shoulder pain. *European spine journal*; 2007.

1250. Harkness, E. F., Macfarlane, G. J., Nahit, E., Silman, A. J., McBeth, J. Mechanical injury and psychosocial factors in the work place predict the onset of widespread body pain: a two-year prospective study among cohorts of newly employed workers. *Arthritis Rheum*; May 2004.

1251. Andersen, J. H., Haahr, J. P., Frost, P. Risk factors for more severe regional musculoskeletal symptoms: a two-year prospective study of a general working population. *Arthritis Rheum*; Apr 2007.

1252. Halonen, J. I., Lallukka, T., Virtanen, M., Rod, N. H., Magnusson Hanson, L. L. Bi-directional relation between effortreward imbalance and risk of neck-shoulder pain: assessment of mediation through depressive symptoms using occupational longitudinal data. *Scand J Work Environ Health*; Mar 1 2019.

1253. Mantyselka, P., Lupsakko, T., Kautiainen, H., Vanhala, M. Neck-shoulder pain and depressive symptoms: a cohort study with a 7-year follow-up. *Eur J Pain*; Feb 2010.

1254. Carbonel, I., Martinez, A. A., Calvo, A., Ripalda, J., Herrera, A. Single-row versus double-row arthroscopic repair in the treatment of rotator cuff tears: a prospective randomized clinical study. *Int Orthop*; Sep 2012.

1255. Myers, D., Silverstein, B., Nelson, N. A. Predictors of shoulder and back injuries in nursing home workers: a prospective study. *Am J Ind Med*; Jun 2002.

1256. Bodin, J., Garlantezec, R., Costet, N., Descatha, A., Viel, J. F., Roquelaure, Y. Risk Factors for Shoulder Pain in a Cohort of French Workers: A Structural Equation Model. *Am J Epidemiol*; Feb 1 2018.

1257. Borg, K., Hensing, G., Alexanderson, K. Predictive factors for disability pension--an 11-year follow up of young persons on sick leave due to neck, shoulder, or back diagnoses. *Scand J Public Health*; Jun 2001.

1258. Hamberg-van Reenen, H. H., Ariens, G. A., Blatter, B. M., van Mechelen, W., Bongers, P. M. A systematic review of the relation between physical capacity and future low back and neck/shoulder pain. *Pain*; Jul 2007.

1259. Karpansalo, M., Manninen, P., Lakka, T. A., Kauhanen, J., Rauramaa, R., Salonen, J. T. Physical workload and risk of early retirement: prospective population-based study among middle-aged men. *J Occup Environ Med*; Oct 2002.

1260. Nakama, K., Gotoh, M., Yamada, T., Mitsui, Y., Yasukawa, H., Imaizumi, T., Higuchi, F., Nagata, K. Interleukin-6-induced activation of signal transducer and activator of transcription-3 in ruptured rotator cuff tendon. *J Int Med Res*; Nov-Dec 2006.

1261. Okamura, K., Kobayashi, T., Yamamoto, A., Shitara, H., Osawa, T., Ichinose, T., Takagishi, K. Shoulder pain and intra-articular interleukin-8 levels in patients with rotator cuff tears. *Int J Rheum Dis*; Feb 2017.

1262. Carp, S. J., Barbe, M. F., Winter, K. A., Amin, M., Barr, A. E. Inflammatory biomarkers increase with severity of upper-extremity overuse disorders. *Clin Sci (Lond)*; Mar 2007.

1263. Franceschi, F., Papalia, R., Paciotti, M., Franceschetti, E., Di Martino, A., Maffulli, N., Denaro, V. Obesity as a risk factor for tendinopathy: a systematic review. *Int J Endocrinol*; 2014.

1264. Rechardt, M., Shiri, R., Karppinen, J., Jula, A., Heliovaara, M., Viikari-Juntura, E. Lifestyle and metabolic factors in relation to shoulder pain and rotator cuff tendinitis: a population-based study. *BMC Musculoskelet Disord*; Jul 20 2010.

1265. Baumgarten, K. M., Gerlach, D., Galatz, L. M., Teefey, S. A., Middleton, W. D., Ditsios, K., Yamaguchi, K. Cigarette smoking increases the risk for rotator cuff tears. *Clin Orthop Relat Res*; Jun 2010.

1266. Leino-Arjas, P. Smoking and musculoskeletal disorders in the metal industry: a prospective study. *Occup Environ Med*; Dec 1998.

1267. Maher, A., Leigh, W., Brick, M., Young, S., Millar, J., Walker, C., Caughey, M. Gender, ethnicity and smoking affect pain and function in patients with rotator cuff tears. *ANZ J Surg*; Sep 2017.

1268. Bishop, J. Y., Santiago-Torres, J. E., Rimmke, N., Flanigan, D. C. Smoking Predisposes to Rotator Cuff Pathology and Shoulder Dysfunction: A Systematic Review. *Arthroscopy*; Aug 2015.

1269. Abboud, J. A., Kim, J. S. The effect of hypercholesterolemia on rotator cuff disease. *Clin Orthop Relat Res*; Jun 2010.

1270. Lin, Tony Tung-Liang, Lin, Ching-Heng, Chang, Chia-Li, Chi, Chun-Han, Chang, Shin-Tsu, Sheu, Wayne Huey-Herng. The effect of diabetes, hyperlipidemia, and statins on the development of rotator cuff disease: a nationwide, 11-year, longitudinal, population-based follow-up study. *The American journal of sports medicine*; 2015.

1271. MacDonald, Austin E, Ekhtiari, Seper, Khan, Moin, Moro, Jaydeep K, Bedi, Asheesh, Miller, Bruce S. Dyslipidaemia is associated with an increased risk of rotator cuff disease: a systematic review. *Journal of ISAKOS: Joint Disorders & Orthopaedic Sports Medicine*; 2017.

1272. Kim, Jae-Min, Kim, Min-Wook, Do, Hyun-Jung. Influence of hyperlipidemia on the treatment of supraspinatus tendinopathy with or without tear. *Annals of rehabilitation medicine*; 2016.

1273. Yang, Yang, Qu, Jin. The effects of hyperlipidemia on rotator cuff diseases: a systematic review. *Journal of orthopaedic surgery and research*; 2018.

1274. Leong, Hio Teng, Chuen Fu, Sai, He, Xin, Han Oh, Joo, Yamamoto, Nobuyuki, Yung, Shu Hang Patrick. Risk factors for rotator cuff tendinopathy: A systematic review and meta-analysis. *Journal of rehabilitation medicine*; 2019.

1275. Cole, A.,et al. Is diabetes associated with shoulder pain or stiffness? Results from a population based study. *J Rheumatol*; 2009.

1276. Titchener, A. G., White, J. J., Hinchliffe, S. R., Tambe, A. A., Hubbard, R. B., Clark, D. I. Comorbidities in rotator cuff disease: a case-control study. *J Shoulder Elbow Surg*; Sep 2014.

1277. Nyman, Teresia, Mulder, Marie, Iliadou, Anastasia, Svartengren, Magnus, Wiktorin, Christina. Physical workload, low back pain and neck–shoulder pain: a Swedish twin study. *Occupational and environmental medicine*; 2009.

1278. Tashjian, R. Z., Farnham, J. M., Albright, F. S., Teerlink, C. C., Cannon-Albright, L. A. Evidence for an inherited predisposition contributing to the risk for rotator cuff disease. *J Bone Joint Surg Am*; May 2009.

1279. Dabija, Dominique I, Gao, Chan, Edwards, Todd L, Kuhn, John E, Jain, Nitin B. Genetic and familial predisposition to rotator cuff disease: a systematic review. *Journal of shoulder and elbow surgery*; 2017.

1280. Djerbi, I., Chammas, M., Mirous, M. P., Lazerges, C., Coulet, B. Impact of cardiovascular risk factor on the prevalence and severity of symptomatic full-thickness rotator cuff tears. *Orthop Traumatol Surg Res*; Oct 2015.

1281. Worland, R. L., Lee, D., Orozco, C. G., SozaRex, F., Keenan, J. Correlation of age, acromial morphology, and rotator cuff tear pathology diagnosed by ultrasound in asymptomatic patients. *J South Orthop Assoc*; Spring 2003.

1282. Sayampanathan, A. A., Andrew, T. H. Systematic review on risk factors of rotator cuff tears. *J Orthop Surg (Hong Kong)*; Jan 2017.

1283. Park, H. B., Gwark, J. Y., Im, J. H., Jung, J., Na, J. B., Yoon, C. H. Factors Associated with Atraumatic Posterosuperior Rotator Cuff Tears. *J Bone Joint Surg Am*; Aug 15 2018.

1284. Yamamoto, Nobuyuki, Mineta, Mitsuyoshi, Kawakami, Jun, Sano, Hirotaka, Itoi, Eiji. Risk factors for tear progression in symptomatic rotator cuff tears: a prospective study of 174 shoulders. *The American journal of sports medicine*; 2017.

1285. Redondo-Alonso, Lucía, Chamorro-Moriana, Gema, Jiménez-Rejano, José Jesús, López-Tarrida, Patricio, Ridao-Fernández, Carmen. Relationship between chronic pathologies of the supraspinatus tendon and the long head of the biceps tendon: systematic review. *BMC musculoskeletal disorders*; 2014.

1286. Gill, T. J., McIrvin, E., Kocher, M. S., Homa, K., Mair, S. D., Hawkins, R. J. The relative importance of acromial morphology and age with respect to rotator cuff pathology. *J Shoulder Elbow Surg*; Jul-Aug 2002.

1287. Lee, M., Chen, J. Y., Liow, M. H. L., Chong, H. C., Chang, P., Lie, D. Critical Shoulder Angle and Acromial Index Do Not Influence 24-Month Functional Outcome After Arthroscopic Rotator Cuff Repair. *Am J Sports Med*; Nov 2017.

1288. Morelli, K. M., Martin, B. R., Charakla, F. H., Durmisevic, A., Warren, G. L. Acromion morphology and prevalence of rotator cuff tear: A systematic review and meta-analysis. *Clin Anat*; Jan 2019.

1289. Ogawa, K., Yoshida, A., Inokuchi, W., Naniwa, T. Acromial spur: relationship to aging and morphologic changes in the rotator cuff. *J Shoulder Elbow Surg*; Nov-Dec 2005.

1290. Lambert, R. G., Dhillon, S. S., Jhangri, G. S., Sacks, J., Sacks, H., Wong, B., Russell, A. S., Maksymowych, W. P. High prevalence of symptomatic enthesopathy of the shoulder in ankylosing spondylitis: deltoid origin involvement constitutes a hallmark of disease. *Arthritis Rheum*; Oct 15 2004.

1291. Kennedy, P., Joshi, R., Dhawan, A. The Effect of Psychosocial Factors on Outcomes in Patients With Rotator Cuff Tears: A Systematic Review. *Arthroscopy*; Sep 2019.

1292. Jay, K., Thorsen, S. V., Sundstrup, E., Aiguade, R., Casana, J., Calatayud, J., Andersen, L. L. Fear Avoidance Beliefs and Risk of Long-Term Sickness Absence: Prospective Cohort Study among Workers with Musculoskeletal Pain. *Pain Res Treat*; 2018.

1293. Aili, K., Nyman, T., Hillert, L., Svartengren, M. Sleep disturbances predict future sickness absence among individuals with lower back or neck-shoulder pain: a 5-year prospective study. *Scand J Public Health*; May 2015.

1294. Rasmussen-Barr, E., Grooten, W. J., Hallqvist, J., Holm, L. W., Skillgate, E. Are job strain and sleep disturbances prognostic factors for neck/shoulder/arm pain? A cohort study of a general population of working age in Sweden. *BMJ Open*; Jul 8 2014.

1295. Stuart, M. J., Smith, A. Injuries in Junior A ice hockey. A three-year prospective study. *Am J Sports Med*; Jul-Aug 1995.

1296. Dohjima, T., Sumi, Y., Ohno, T., Sumi, H., Shimizu, K. The dangers of snowboarding: a 9-year prospective comparison of snowboarding and skiing injuries. *Acta Orthop Scand*; Dec 2001.

1297. Webb, J., Bannister, G. Acromioclavicular disruption in first class rugby players. *Br J Sports Med*; Dec 1992.

1298. Nordqvist, A., Petersson, C. J. Incidence and causes of shoulder girdle injuries in an urban population. *J Shoulder Elbow Surg*; Mar-Apr 1995.

1299. Laprade, R. F., Surowiec, R. K., Sochanska, A. N., Hentkowski, B. S., Martin, B. M., Engebretsen, L., Wijdicks, C. A. Epidemiology, identification, treatment and return to play of musculoskeletal-based ice hockey injuries. *Br J Sports Med*; Jan 2014.

1300. Hibberd, E. E., Kerr, Z. Y., Roos, K. G., Djoko, A., Dompier, T. P. Epidemiology of Acromioclavicular Joint Sprains in 25 National Collegiate Athletic Association Sports: 2009-2010 to 2014-2015 Academic Years. *Am J Sports Med*; Oct 2016.

1301. Melvin, P. R., Souza, S., Mead, R. N., Smith, C., Mulcahey, M. K. Epidemiology of Upper Extremity Injuries in NCAA Men's and Women's Ice Hockey. *Am J Sports Med*; Aug 2018.

1302. Frey, A., Lambert, C., Vesselle, B., Rousseau, R., Dor, F., Marquet, L. A., Toussaint, J. F., Crema, M. D. Epidemiology of Judo-Related Injuries in 21 Seasons of Competitions in France: A Prospective Study of Relevant Traumatic Injuries. *Orthop J Sports Med*; May 2019.

1303. Montgomery, C., O'Briain, D. E., Hurley, E. T., Pauzenberger, L., Mullett, H., Moran, C. J. Video Analysis of Shoulder Dislocations in Rugby: Insights Into the Dislocating Mechanisms. *Am J Sports Med*; Dec 2019.

1304. Goodman, A. D., Twomey-Kozak, J., DeFroda, S. F., Owens, B. D. Epidemiology of shoulder and elbow injuries in National Collegiate Athletic Association wrestlers, 2009-2010 through 2013-2014. *Phys Sportsmed*; Sep 2018.

1305. Goodman, A.D.,et al. Season-Ending Shoulder Injuries in the National Collegiate Athletic Association: Data From the NCAA Injury Surveillance Program, 2009-2010 Through 2013-2014. *Am J Sports Med*; 2018.

1306. Goodman, A. D., Raducha, J. E., DeFroda, S. F., Gil, J. A., Owens, B. D. Shoulder and elbow injuries in NCAA football players, 2009-2010 through 2013-2014. *Phys Sportsmed*; Sep 2019.

1307. Valdes, A. M., Loughlin, J., Oene, M. V., Chapman, K., Surdulescu, G. L., Doherty, M., Spector, T. D. Sex and ethnic differences in the association of ASPN, CALM1, COL2A1, COMP, and FRZB with genetic susceptibility to osteoarthritis of the knee. *Arthritis Rheum*; Jan 2007.

1308. Valdes, A. M., Spector, T. D. Genetic epidemiology of hip and knee osteoarthritis. *Nat Rev Rheumatol*; Jan 2011.

1309. Zhang, Yuqing, Jordan, Joanne M. Epidemiology of osteoarthritis. *Clinics in geriatric medicine*; 2010.

1310. Kellgren, JH. Primary generalised osteoarthritis. *Bulletin on the rheumatic diseases*; 1954.

1311. Kellgren, JH. Osteoarthrosis in patients and populations. *British Medical Journal*; 1961.

1312. Kellgren, JH, Lawrence, JS. Osteo-arthrosis and disk degeneration in an urban population. *Annals of the Rheumatic Diseases*; 1958.

1313. Kellgren, JH, Lawrence, JS, Bier, Frida. Genetic factors in generalized osteo-arthrosis. *Annals of the rheumatic diseases*; 1963.

1314. Kellgren, JH, Moore, R. Generalized osteoarthritis and Heberden's nodes. *British medical journal*; 1952.

1315. Meachim, G., Whitehouse, G. H., Pedley, R. B., Nichol, F. E., Owen, R. An investigation of radiological, clinical and pathological correlations in osteoarthrosis of the hip. *Clin Radiol*; Sep 1980.

1316. Nakagawa, Yasuaki, Hyakuna, Katsufumi, Otani, Shigeru, Hashitani, Minoru, Nakamura, Takashi. Epidemiologic study of glenohumeral osteoarthritis with plain radiography. *Journal of Shoulder and Elbow Surgery*; 1999/11/01/.

1317. Mahakkanukrauh, P., Surin, P. Prevalence of osteophytes associated with the acromion and acromioclavicular joint. *Clin Anat*; Nov 2003.

1318. Lehtinen, J. T., Kaarela, K., Belt, E. A., Kautiainen, H. J., Kauppi, M. J., Lehto, M. U. Incidence of acromioclavicular joint involvement in rheumatoid arthritis: a 15 year endpoint study. *J Rheumatol*; Jun 1999.

1319. Felson, D. T., Anderson, J. J., Naimark, A., Walker, A. M., Meenan, R. F. Obesity and knee osteoarthritis. The Framingham Study. *Ann Intern Med*; Jul 1 1988.

1320. Oliveria, S. A., Felson, D. T., Cirillo, P. A., Reed, J. I., Walker, A. M. Body weight, body mass index, and incident symptomatic osteoarthritis of the hand, hip, and knee. *Epidemiology*; Mar 1999.

1321. Krøner, K., Lind, T., Jensen, J. The epidemiology of shoulder dislocations. *Arch Orthop Trauma Surg*; 1989.

1322. Stenlund, B., Goldie, I., Hagberg, M., Hogstedt, C., Marions, O. Radiographic osteoarthrosis in the acromioclavicular joint resulting from manual work or exposure to vibration. *Br J Ind Med*; Aug 1992.

1323. Raynor, M.B., Kuhn, J.E. Utility of features of the patient's history in the diagnosis of atraumatic shoulder pain: a systematic review. *J Shoulder Elbow Surg*; 2016.

1324. Tzeng, C. Y., Chiang, H. Y., Huang, C. C., Lin, W. S., Hsiao, T. H., Lin, C. H. The impact of pre-existing shoulder diseases and traumatic injuries of the shoulder on adhesive capsulitis in adult population: A population-based nested case-control study. *Medicine (Baltimore)*; Sep 2019.

1325. White, D.,et al. Secular trend of adhesive capsulitis. *Arthritis Care Res*; 2011.

1326. Kingston, K., Curry, E. J., Galvin, J. W., Li, X. Shoulder adhesive capsulitis: epidemiology and predictors of surgery. *J Shoulder Elbow Surg*; Aug 2018.

1327. Wang, K.,et al. Risk factors in idiopathic adhesive capsulitis: a case control study. *J Shoulder Elbow Surg*; 2013.

1328. Hsu, K. C., Sun, C. H., Wu, Y. Y., Chen, L. C., Wu, Y. T., Chien, W. C. Increased risk of adhesive capsulitis among patients with gout: A nationwide population-based matched-cohort study. *Int J Rheum Dis*; Sep 2018.

1329. Park, H. B., Gwark, J. Y., Jung, J., Jeong, S. T. Association Between High-Sensitivity C-Reactive Protein and Idiopathic Adhesive Capsulitis. *J Bone Joint Surg Am*; Feb 20 2020.

1330. Rai, S. K., Kashid, M., Chakrabarty, B., Upreti, V., Shaki, O. Is it necessary to screen patient with adhesive capsulitis of shoulder for diabetes mellitus? *J Family Med Prim Care*; Sep 2019.

1331. Balci, N., Balci, M. K., Tuzuner, S. Shoulder adhesive capsulitis and shoulder range of motion in type II diabetes mellitus: association with diabetic complications. *J Diabetes Complications*; May-Jun 1999.

1332. Arkkila, P.E.,et al. Shoulder capsulitis in type I and II diabetic patients: association with diabetic complications and related diseases. *Ann Rheum Dis*; 1996.

1333. Meixner, C., Loder, R. T. The Demographics of Fractures and Dislocations Across the Entire United States due to Common Sports and Recreational Activities. *Sports Health*; Mar/Apr 2020.

1334. Lind, T., Kroner, K., Jensen, J. The epidemiology of fractures of the proximal humerus. *Arch Orthop Trauma Surg*; 1989.

1335. Hovelius, L, Olofsson, A, Sandstrom, B, Augustini, BG, Krantz, L, Fredin, H, Tillander, B, Skoglund, U, Salomonsson, B, Nowak, J, Sennerby, U. Nonoperative treatment of primary anterior shoulder dislocation in patients forty years of age and younger. A prospective twenty-five year follow-up. *J Bone Joint Surg Am*; 2008.

1336. Griffith, JF, Antonio, GE, Yung, PS, Wong, EM, Yu, AB, Ahuja, AT, Chan, KM. Prevalence, pattern, and spectrum of glenoid bone loss in anterior shoulder dislocation: CT analysis of 218 patients. *Am J Roentgenol*; 2008.

1337. Owens, BD, Duffey, ML, Nelson, BJ, DeBerardino, TM, Taylor, DC, Mountcastle, SB. The incidence and characteristics of shoulder instability at the United States Military Academy. *Am J Sports Med*; 2007.

1338. Headey, J, Brooks, JH, Kemp, SP. The epidemiology of shoulder injuries in English professional rugby union. *Am J Sports Med*; 2007.

1339. Cho, N.,J. Hwang,and Y. Rhee. Arthroscopic stabilization in anterior shoulder instability: collision athletes versus noncollision athletes. *Arthroscopy*; 2006.

1340. Vermeiren, J, Handelberg, F, Casteleyn, PP, Opdecam, P. The rate of recurrence of traumatic anterior dislocation of the shoulder. A study of 154 cases and a review of the literature. *Int Orthop*; 1993.

1341. Leroux, T.,et al. Combined arthroscopic Bankart repair and remplissage for recurrent shoulder instability. *Arthroscopy*; 2013.

1342. Shields, D. W., Jefferies, J. G., Brooksbank, A. J., Millar, N., Jenkins, P. J. Epidemiology of glenohumeral dislocation and subsequent instability in an urban population. *J Shoulder Elbow Surg*; Feb 2018.

1343. Shah, A., Judge, A., Delmestri, A., Edwards, K., Arden, N. K., Prieto-Alhambra, D., Holt, T. A., Pinedo-Villanueva, R. A., Hopewell, S., Lamb, S. E., Rangan, A., Carr, A. J., Collins, G. S., Rees, J. L. Incidence of shoulder dislocations in the UK, 1995-2015: a population-based cohort study. *BMJ Open*; Nov 14 2017.

1344. Myers, JB, Ju, YY, Hwang, JH, McMahon, PJ, Rodosky, MW, Lephart, SM. Reflexive muscle activation alterations in shoulders with anterior glenohumeral instability. *Am J Sports Med*; 2004.

1345. Moreau, CE, Moreau, SR. Chiropractic management of a professional hockey player with recurrent shoulder instability. *J Manipulative Physiol Ther*; 2001.

1346. Wasserstein, D. N., Sheth, U., Colbenson, K., Henry, P. D., Chahal, J., Dwyer, T., Kuhn, J. E. The True Recurrence Rate and Factors Predicting Recurrent Instability After Nonsurgical Management of Traumatic Primary Anterior Shoulder Dislocation: A Systematic Review. *Arthroscopy*; Dec 2016.

1347. Kardouni, J.R., C.J., McKinnon, Seitz, A.L. Incidence of Shoulder Dislocations and the Rate of Recurrent Instability in Soldiers. *Med Sci Sports Exerc*; 2016.

1348. Kralinger, F.S.,et al. Predicting recurrence after primary anterior shoulder dislocation. *Am J Sports Med*; 2002.

1349. Longo, U.G.,et al. Management of primary acute anterior shoulder dislocation: systematic review and quantitative synthesis of the literature. *Arthroscopy*; 2014.

1350. Olds, M., Ellis, R., Donaldson, K., Parmar, P., Kersten, P. Risk factors which predispose first-time traumatic anterior shoulder dislocations to recurrent instability in adults: a systematic review and meta-analysis. *Br J Sports Med*; Jul 2015.

1351. Shibata, Y, Honjo, N, Shinoda, T, Kumano, T, Naito, M. Pressure between the humeral head and the subscapularis tendon after the modified Boytchev procedure. *J Shoulder Elbow Surg*; 2004.

1352. Horst, K., Von Harten, R., Weber, C., Andruszkow, H., Pfeifer, R., Dienstknecht, T., Pape, H. C. Assessment of coincidence and defect sizes in Bankart and Hill-Sachs lesions after anterior shoulder dislocation: a radiological study. *Br J Radiol*; Feb 2014.

1353. Orvets, N. D., Parisien, R. L., Curry, E. J., Chung, J. S., Eichinger, J. K., Murakami, A. M., Li, X. Acute Versus Delayed Magnetic Resonance Imaging and Associated Abnormalities in Traumatic Anterior Shoulder Dislocations. *Orthop J Sports Med*; Sep 2017.

1354. Vahedi, H., Fleischman, A. N., Salvo, J. P.,Jr., Parvizi, J. Higher Prevalence of Concomitant Shoulder Labral Tears in Patients With Femoroacetabular Impingement. *Arthroscopy*; Apr 2019.

1355. Schwartzberg, R., Reuss, B. L., Burkhart, B. G., Butterfield, M., Wu, J. Y., McLean, K. W. High Prevalence of Superior Labral Tears Diagnosed by MRI in Middle-Aged Patients With Asymptomatic Shoulders. *Orthop J Sports Med*; Jan 2016.

1356. Gill, T. K., Shanahan, E. M., Allison, D., Alcorn, D., Hill, C. L. Prevalence of abnormalities on shoulder MRI in symptomatic and asymptomatic older adults. *Int J Rheum Dis*; Nov 2014.

1357. Mannava, S., Frangiamore, S. J., Murphy, C. P., Sanchez, A., Sanchez, G., Dornan, G. J., Bradley, J. P., LaPrade, R. F., Millett, P. J., Provencher, M. T. Prevalence of Shoulder Labral Injury in Collegiate Football Players at the National Football League Scouting Combine. *Orthop J Sports Med*; Jul 2018.

1358. Lansdown, D.A.,et al. Imaging-Based Prevalence of Superior Labral Anterior-Posterior Tears Significantly Increases in the Aging Shoulder. *Orthop J Sports*; 2018.

1359. DePalma, AF, Callery, G, Bennett, GA. Variational anatomy and degenerative lesions of the shoulder joint. *AAOS Instructional Course Lect*; 1949.

1360. Kuorinka, I., Koskinen, P. Occupational rheumatic diseases and upper limb strain in manual jobs in a light mechanical industry. *Scand J Work Environ Health*; 1979.

1361. Knave, B. G., Wibom, R. I., Bergqvist, U. O., Carlsson, L. L., Levin, M. I., Nylen, P. R. Work with video display terminals among office employees. II. Physical exposure factors. *Scand J Work Environ Health*; Dec 1985.

1362. Yu, ITS, Wong, TW. Musculoskeletal problems among VDU workers in a Hong Kong bank. *Occup Med*; 1996.

1363. Rudolph, L. NIOSH Research Projects. Musculoskeletal disorders: physicians and the return-to-work- process. 1997.

1364. Velly, A. M., Gornitsky, M., Philippe, P. Contributing factors to chronic myofascial pain: a case-control study. *Pain*; Aug 2003.

1365. Treaster, D., Marras, W. S., Burr, D., Sheedy, J. E., Hart, D. Myofascial trigger point development from visual and postural stressors during computer work. *J Electromyogr Kinesiol*; Apr 2006.

1366. Hoyle, J. A., Marras, W. S., Sheedy, J. E., Hart, D. E. Effects of postural and visual stressors on myofascial trigger point development and motor unit rotation during computer work. *J Electromyogr Kinesiol*; Feb 2011.

1367. Do, T. P., Heldarskard, G. F., Kolding, L. T., Hvedstrup, J., Schytz, H. W. Myofascial trigger points in migraine and tension-type headache. *J Headache Pain*; Sep 10 2018.

1368. Stratton, P., Khachikyan, I., Sinaii, N., Ortiz, R., Shah, J. Association of chronic pelvic pain and endometriosis with signs of sensitization and myofascial pain. *Obstet Gynecol*; Mar 2015.

1369. Itza, F., Zarza, D., Salinas, J., Teba, F., Ximenez, C. Turn-amplitude analysis as a diagnostic test for myofascial syndrome in patients with chronic pelvic pain. *Pain Res Manag*; Mar-Apr 2015.

1370. Alonso-Blanco, C., Fernandez-de-Las-Penas, C., de-la-Llave-Rincon, A. I., Zarco-Moreno, P., Galan-Del-Rio, F., Svensson, P. Characteristics of referred muscle pain to the head from active trigger points in women with myofascial temporomandibular pain and fibromyalgia syndrome. *J Headache Pain*; Nov 2012.

1371. Gane, E. M., Michaleff, Z. A., Cottrell, M. A., McPhail, S. M., Hatton, A. L., Panizza, B. J., O'Leary, S. P. Prevalence, incidence, and risk factors for shoulder and neck dysfunction after neck dissection: A systematic review. *Eur J Surg Oncol*; Jul 2017.

1372. Jones, M. R., Prabhakar, A., Viswanath, O., Urits, I., Green, J. B., Kendrick, J. B., Brunk, A. J., Eng, M. R., Orhurhu, V., Cornett, E. M., Kaye, A. D. Thoracic Outlet Syndrome: A Comprehensive Review of Pathophysiology, Diagnosis, and Treatment. *Pain Ther*; Jun 2019.

1373. Laulan, J., Fouquet, B., Rodaix, C., Jauffret, P., Roquelaure, Y., Descatha, A. Thoracic outlet syndrome: definition, aetiological factors, diagnosis, management and occupational impact. *J Occup Rehabil*; Sep 2011.

1374. Sheth, R. N., Belzberg, A. J. Diagnosis and treatment of thoracic outlet syndrome. *Neurosurg Clin N Am*; Apr 2001.

1375. Wilbourn, A. J. The thoracic outlet syndrome is overdiagnosed. *Arch Neurol*; Mar 1990.

1376. Hooper, T. L., Denton, J., McGalliard, M. K., Brismee, J. M., Sizer, P. S.,Jr. Thoracic outlet syndrome: a controversial clinical condition. Part 1: anatomy, and clinical examination/diagnosis. *J Man Manip Ther*; Jun 2010.

1377. Watson, L. A., Pizzari, T., Balster, S. Thoracic outlet syndrome part 1: clinical manifestations, differentiation and treatment pathways. *Man Ther*; Dec 2009.

1378. Harkness, EF, MacFarlane, Gary John, Nahit, ES, Silman, AJ, McBeth, J. Mechanical and psychosocial factors predict new onset shoulder pain: a prospective cohort study of newly employed workers. *Occupational and environmental medicine*; 2003.

1379. Beach, J., Senthilselvan, A., Cherry, N. Factors affecting work-related shoulder pain. *Occup Med (Lond)*; Sep 2012.

1380. Pope, D. P., Silman, A. J., Cherry, N. M., Pritchard, C., Macfarlane, G. J. Association of occupational physical demands and psychosocial working environment with disabling shoulder pain. *Ann Rheum Dis*; Sep 2001.

1381. van der Windt, D. A., Thomas, E., Pope, D. P., de Winter, A. F., Macfarlane, G. J., Bouter, L. M., Silman, A. J. Occupational risk factors for shoulder pain: a systematic review. *Occup Environ Med*; Jul 2000.

1382. McMaster, W. C., Troup, J. A survey of interfering shoulder pain in United States competitive swimmers. *Am J Sports Med*; Jan-Feb 1993.

1383. Rupp, S., Berninger, K., Hopf, T. Shoulder problems in high level swimmers--impingement, anterior instability, muscular imbalance? *Int J Sports Med*; Nov 1995.

1384. Richardson, A. B., Jobe, F. W., Collins, H. R. The shoulder in competitive swimming. *Am J Sports Med*; May-Jun 1980.

1385. Penny, J. N., Smith, C. The prevention and treatment of swimmer's shoulder. *Can J Appl Sport Sci*; Sep 1980.

1386. Kennedy, J. C., Hawkins, R., Krissoff, W. B. Orthopaedic manifestations of swimming. *Am J Sports Med*; Nov-Dec 1978.

1387. Bak, K. and P. Fauno. Clinical findings in competitive swimmers with shoulder pain. *Am J Sports Med*; 1997.

1388. Stocker, D., Pink, M., Jobe, F. W. Comparison of shoulder injury in collegiate- and master's-level swimmers. *Clin J Sport Med*; 1995.

1389. Rempel, D. M., Krause, N., Goldberg, R., Benner, D., Hudes, M., Goldner, G. U. A randomised controlled trial evaluating the effects of two workstation interventions on upper body pain and incident musculoskeletal disorders among computer operators. *Occup Environ Med*; May 2006.

1390. Verhagen, A. P., Karels, C., Bierma-Zeinstra, S. M., Burdorf, L., Feleus, A., Dahaghin, S., de Vet, H. C., Koes, B. W. Ergonomic and physiotherapeutic interventions for treating work-related complaints of the arm, neck or shoulder in adults. *Cochrane Database Syst Rev*; 2006.

1391. Voerman, Gerlienke E, Sandsjö, Leif, Vollenbroek-Hutten, Miriam MR, Larsman, Pernilla, Kadefors, Roland, Hermens, Hermie J. Effects of ambulant myofeedback training and ergonomic counselling in female computer workers with work-related neck-shoulder complaints: a randomized controlled trial. *Journal of occupational rehabilitation*; 2007.

1392. Voerman, Gerlienke E, Vollenbroek-Hutten, Miriam MR, Sandsjö, Leif, Kadefors, Roland, Hermens, Hermie J. Prognostic factors for the effects of two interventions for work-related neck–shoulder complaints: Myofeedback training and ergonomic counselling. *Applied ergonomics*; 2008.

1393. Krause, Niklas, Burgel, Barbara, Rempel, David. Effort-reward imbalance and one-year change in neck-shoulder and upper-extremity pain among call center computer operators. *Scandinavian journal of work, environment & health*; 2010.

1394. Martimo, Kari-Pekka, Shiri, Rahman, Miranda, Helena, Ketola, Ritva, Varonen, Helena, Viikari-Juntura, Eira. Effectiveness of an ergonomic intervention on the productivity of workers with upper-extremity disorders-a randomized controlled trial. *Scandinavian journal of work, environment & health*; 2010.

1395. Shiri, Rahman, Martimo, Kari-Pekka, Miranda, Helena, Ketola, Ritva, Kaila-Kangas, Leena, Liira, Helena, Karppinen, Jaro, Viikari-Juntura, Eira. The effect of workplace intervention on pain and sickness absence caused by upper-extremity musculoskeletal disorders. *Scandinavian journal of work, environment & health*; 2011.

1396. Hoe, Victor CW, Urquhart, Donna M, Kelsall, Helen L, Sim, Malcolm R. Ergonomic design and training for preventing work-related musculoskeletal disorders of the upper limb and neck in adults. *Cochrane Database of Systematic Reviews*; 2012.

1397. Mahmud, Norashikin, Kenny, Dianna T, Rahman, Hamidah Ab. The effect of workplace office ergonomics intervention on reducing neck and shoulder complaints and sickness absence. *International Proceedings of Economics Development & Research*; 2012.

1398. Verhagen, Arianne P, Bierma-Zeinstra, Sita MA, Burdorf, Alex, Stynes, Siobhan M, de Vet, Henrica CW, Koes, Bart W. Conservative interventions for treating work-related complaints of the arm, neck or shoulder in adults. *Cochrane Database of Systematic Reviews*; 2013.

1399. Esmaeilzadeh, Sina, Ozcan, Emel, Capan, Nalan. Effects of ergonomic intervention on work-related upper extremity musculoskeletal disorders among computer workers: a randomized controlled trial. *International archives of occupational and environmental health*; 2014.

1400. Sundstrup, Emil, Jakobsen, Markus D, Brandt, Mikkel, Jay, Kenneth, Persson, Roger, Aagaard, Per, Andersen, Lars L. Workplace strength training prevents deterioration of work ability among workers with chronic pain and work disability: a randomized controlled trial. *Scandinavian journal of work, environment & health*; 2014.

1401. Varatharajan, Sharanya, Côté, Pierre, Shearer, Heather M, Loisel, Patrick, Wong, Jessica J, Southerst, Danielle, Yu, Hainan, Randhawa, Kristi, Sutton, Deborah, van der Velde, Gabrielle. Are work disability prevention interventions effective for the management of neck pain or upper extremity disorders? A systematic review by the Ontario Protocol for Traffic Injury Management (OPTIMa) collaboration. *Journal of occupational rehabilitation*; 2014.

1402. Aghilinejad, Mashallah, Kabir-Mokamelkhah, Elahe, Labbafinejad, Yasser, Bahrami-Ahmadi, Amir, Hosseini, Hamid Reza. The role of ergonomic training interventions on decreasing neck and shoulders pain among workers of an Iranian automobile factory: a randomized trial study. *Medical journal of the Islamic Republic of Iran*; 2015.

1403. Hutting, Nathan, Staal, J Bart, Engels, Josephine A, Heerkens, Yvonne F, Detaille, Sarah I, Nijhuis-van der Sanden, Maria WG. Effect evaluation of a self-management programme for employees with complaints of the arm, neck or shoulder: a randomised controlled trial. *Occupational and environmental medicine*; 2015.

1404. Lowry, Veronique, Desjardins-Charbonneau, Ariel, Roy, Jean-Sebastien, Dionne, Clermont E, Fremont, Pierre, MacDermid, Joy C, Desmeules, Francois. Efficacy of workplace interventions for shoulder pain: A systematic review and meta-analysis. 2017.

1405. Marik, Tambra L, Roll, Shawn C. Effectiveness of occupational therapy interventions for musculoskeletal shoulder conditions: a systematic review. *American Journal of Occupational Therapy*; 2017.

1406. Hoe, Victor CW, Urquhart, Donna M, Kelsall, Helen L, Zamri, Eva N, Sim, Malcolm R. Ergonomic interventions for preventing work-related musculoskeletal disorders of the upper limb and neck among office workers. *Cochrane Database of Systematic Reviews*; 2018.

1407. Mulimani, Priti, Hoe, Victor CW, Hayes, Melanie J, Idiculla, Jose Joy, Abas, Adinegara BL, Karanth, Laxminarayan. Ergonomic interventions for preventing musculoskeletal disorders in dental care practitioners. *Cochrane Database of Systematic Reviews*; 2018.

1408. Stock, Susan R, Nicolakakis, Nektaria, Vezina, M, Vezina, Nicole, Gilbert, Louis, Turcot, Alice, Sultan-Taieb, Helene, Sinden, Kathryn, Denis, Marie-Agnès, Delga, Céline. Are work organization interventions effective in preventing or reducing work-related musculoskeletal disorders? A systematic review of the literature. 2018.

1409. Tsang, Sharon MH, So, Billy CL, Lau, Rufina WL, Dai, Jie, Szeto, Grace PY. Effects of combining ergonomic interventions and motor control exercises on muscle activity and kinematics in people with work-related neck–shoulder pain. *European journal of applied physiology*; 2018.

1410. Bazazan A, et al. Effect of a posture correction–based intervention on musculoskeletal symptoms and fatigue among control room operators. *Appl Ergonomics*; 2019.

1411. Karimian, Razieh, Rahnama, Nader, Ghasemi, Gholamali, Lenjannejadian, Shahram. Photogrammetric Analysis of Upper Cross Syndrome among Teachers and the Effects of National Academy of Sports Medicine Exercises with Ergonomic Intervention on the Syndrome. *Journal of research in health sciences*; 2019.

1412. So BC, et al. Effects of ergomotor intervention on improving occupational health in workers with work-related neck-shoulder pain. *Int J Environ Res Public Health*; 2019.

1413. Tsang, Sharon MH, So, Billy CL, Lau, Rufina WL, Dai, Jie, Szeto, Grace PY. Comparing the effectiveness of integrating ergonomics and motor control to conventional treatment for pain and functional recovery of work-related neck–shoulder pain: A randomized trial. *European Journal of Pain*; 2019.

1414. Keogh, J. P., Nuwayhid, I., Gordon, J. L., Gucer, P. W. The impact of occupational injury on injured worker and family: outcomes of upper extremity cumulative trauma disorders in Maryland workers. *Am J Ind Med*; Nov 2000.

1415. Nakphet, Nuttika, Chaikumarn, Montakarn, Janwantanakul, Prawit. Effect of different types of rest-break interventions on neck and shoulder muscle activity, perceived discomfort and productivity in symptomatic VDU operators: a randomized controlled trial. *International journal of occupational safety and ergonomics*; 2014.

1416. Baker, Nancy A, Moehling, Krissy K, Park, Seo Young. The effect of an alternative keyboard on musculoskeletal discomfort: A randomized cross-over trial. *Work*; 2015.

1417. Conlon, Craig F, Krause, Niklas, Rempel, David M. A randomised controlled trial evaluating an alternative mouse and forearm support on upper body discomfort and musculoskeletal disorders among engineers. *Occupational and environmental medicine*; 2008.

1418. Basahel, Abdulrahman M. Evaluation of the Impact of Engineering Ergonomic Interventions on Musculoskeletal Hazards and Psychosocial Factors Among Packaging Workers in a Food Factory. 2016.

1419. Lowe, Brian D, Shaw, Peter B, Wilson, Sean R, Whitaker, John R, Witherspoon, Greg J, Hudock, Stephen D, Barrero, Marisol, Ray, Tapas K, Wurzelbacher, Steven J. Evaluation of a workplace exercise program for control of shoulder disorders in overhead assembly work. *Journal of occupational and environmental medicine*; 2017.

1420. Sanaeinasab, Hormoz, Saffari, Mohsen, Valipour, Firouz, Alipour, Hassan Reza, Sepandi, Mojtaba, Al Zaben, Faten, Koenig, Harold G. The effectiveness of a model-based health education intervention to improve ergonomic posture in office computer workers: A randomized controlled trial. *International archives of occupational and environmental health*; 2018.

1421. Rempel, DM, Krause, N, Goldberg, R, Benner, D, Hudes, M, Goldner, GU. A randomised controlled trial evaluating the effects of two workstation interventions on upper body pain and incident musculoskeletal disorders among computer operators. *Occupational and environmental medicine*; 2006.

1422. Dropkin, Jonathan, Kim, Hyun, Punnett, Laura, Wegman, David H, Warren, Nicholas, Buchholz, Bryan. Effect of an office ergonomic randomised controlled trial among workers with neck and upper extremity pain. *Occupational and environmental medicine*; 2015.

1423. Shariat, Ardalan, Cleland, Joshua A, Danaee, Mahmoud, Kargarfard, Mehdi, Sangelaji, Bahram, Tamrin, Shamsul Bahri Mohd. Effects of stretching exercise training and ergonomic modifications on musculoskeletal discomforts of office workers: a randomized controlled trial. *Brazilian journal of physical therapy*; 2018.

1424. Ting, Joshua Zheng Rui, Chen, Xiaoqi, Johnston, Venerina. Workplace-Based Exercise Intervention Improves Work Ability in Office Workers: A Cluster Randomised Controlled Trial. *International journal of environmental research and public health*; 2019.

1425. Choobineh, Alireza, Motamedzade, Majid, Kazemi, Maryam, Moghimbeigi, Abbas, Pahlavian, Ahmad Heidari. The impact of ergonomics intervention on psychosocial factors and musculoskeletal symptoms among office workers. *International Journal of Industrial Ergonomics*; 2011.

1426. Taieb-Maimon, Meirav, Cwikel, Julie, Shapira, Bracha, Orenstein, Ido. The effectiveness of a training method using self-modeling webcam photos for reducing musculoskeletal risk among office workers using computers. *Applied ergonomics*; 2012.

1427. Robertson, Michelle M, Ciriello, Vincent M, Garabet, Angela M. Office ergonomics training and a sit-stand workstation: Effects on musculoskeletal and visual symptoms and performance of office workers. *Applied ergonomics*; 2013.

1428. Baydur, Hakan, Ergör, Alp, Demiral, Yücel, Akalın, Elif. Effects of participatory ergonomic intervention on the development of upper extremity musculoskeletal disorders and disability in office employees using a computer. *Journal of occupational health*; 2016.

1429. Mahmud, Norashikin, Kenny, Dianna Theadora, Zein, Raemy Md, Hassan, Siti Nurani. Ergonomic training reduces musculoskeletal disorders among office workers: results from the 6-month follow-up. *The Malaysian journal of medical sciences: MJMS*; 2011.

1430. Cann, A. P., Connolly, M., Ruuska, R., MacNeil, M., Birmingham, T. B., Vandervoort, A. A., Callaghan, J. P. Inter-rater reliability of output measures for a posture matching assessment approach: a pilot study with food service workers. *Ergonomics*; Apr 2008.

1431. Stephens, J. P., Vos, G. A., Stevens, E. M.,Jr., Moore, J. S. Test-retest repeatability of the Strain Index. *Appl Ergon*; May 2006.

1432. Rucker, N., Moore, J. S. Predictive validity of the strain index in manufacturing facilities. *Appl Occup Environ Hyg*; Jan 2002.

1433. Hughes, R. E., An, K. N. Force analysis of rotator cuff muscles. *Clin Orthop Relat Res*; Sep 1996.

1434. Miranda, Marta Oñate, Bureau, Nathalie J. Supraspinatus myotendinous junction injuries: MRI findings and prevalence. *American Journal of Roentgenology*; 2019.

1435. Hackett, Lisa, Millar, Neal L, Lam, Patrick, Murrell, George AC. Are the symptoms of calcific tendinitis due to neoinnervation and/or neovascularization? *JBJS*; 2016.

1436. Kardouni, Joseph R, Seitz, Amee L, Walsworth, Matthew K, Michener, Lori A. Neovascularization prevalence in the supraspinatus of patients with rotator cuff tendinopathy. *Clinical Journal of Sport Medicine*; 2013.

1437. Shindle, Michael K, Chen, Christopher CT, Robertson, Catherine, DiTullio, Alexandra E, Paulus, Megan C, Clinton, Camille M, Cordasco, Frank A, Rodeo, Scott A, Warren, Russell F. Full-thickness supraspinatus tears are associated with more synovial inflammation and tissue degeneration than partial-thickness tears. *Journal of shoulder and elbow surgery*; 2011.

1438. HajAssaad, Ahmad, Willacy, Rolanda, Wilson, Robert. A Systematic Review of the Histological and Molecular Changes in the Subacromial Bursa in Rotator Cuff Disease. *Journal of surgical orthopaedic advances*; 2020.

1439. Plachel, Fabian, Heuberer, Philipp, Gehwolf, Renate, Frank, Julia, Tempfer, Herbert, Lehner, Christine, Weissenbacher, Nadja, Wagner, Andrea, Weigl, Moritz, Moroder, Philipp. MicroRNA profiling reveals distinct signatures in degenerative rotator cuff pathologies. *Journal of Orthopaedic Research®*; 2020.

1440. Miao, Kaisong, Jiang, Lifeng, Zhou, Xindie, Wu, Lidong, Huang, Yong, Xu, Nanwei, Zhang, Junjie, Li, Jin. Role of matrix metalloproteases 1/3 gene polymorphisms in patients with rotator cuff tear. *Bioscience reports*; 2019.

1441. Raz, Yotam, Henseler, Jan Ferdinand, Kolk, Arjen, Tatum, Zuotian, Groosjohan, Niels Kuipers, Verwey, Nisha E, Arindrarto, Wibowo, Kielbasa, Szymon M, Nagels, Jochem, AC't Hoen, Peter. Molecular signatures of age-associated chronic degeneration of shoulder muscles. *Oncotarget*; 2016.

1442. Li, Jia, Liu, Zheng-Peng, Xu, Cong, Guo, Ai. TGF-β1-containing exosomes derived from bone marrow mesenchymal stem cells promote proliferation, migration and fibrotic activity in rotator cuff tenocytes. *Regenerative therapy*; 2020.

1443. Shih, Chien-An, Wu, Kuo-Chen, Shao, Chung-Jung, Chern, Tai-Chang, Su, Wei-Ren, Wu, Po-Ting, Jou, I-Ming. Synovial fluid biomarkers: association with chronic rotator cuff tear severity and pain. *Journal of shoulder and elbow surgery*; 2018.

1444. Abrams, Geoffrey D, Luria, Ayala, Carr, Rebecca A, Rhodes, Christopher, Robinson, William H, Sokolove, Jeremy. Association of synovial inflammation and inflammatory mediators with glenohumeral rotator cuff pathology. *Journal of shoulder and elbow surgery*; 2016.

1445. Suh, Young Sun, Kim, Hyun-Ok, Cheon, Yun-Hong, Kim, Mingyo, Kim, Rock-Bum, Park, Ki-Soo, Park, Hyung Bin, Na, Jae-Beom, Moon, Jin Il, Lee, Sang-Il. Metabolic and inflammatory links to rotator cuff tear in hand osteoarthritis: A cross sectional study. *PloS one*; 2020.

1446. Gumina, Stefano, Villani, Ciro, Arceri, Valerio, Fagnani, Corrado, Nisticò, Lorenza, Venditto, Teresa, Castagna, Alessandro, Candela, Vittorio. Rotator Cuff Degeneration: The Role of Genetics. *JBJS*; 2019.

1447. Seo, C. M., Kim, K., Jeon, A., Uhm, C. S., Lee, J. H., Han, S. H. Clinical Anatomy for the Innervated Pattern and Boundary of the Subdeltoid Bursa. *Biomed Res Int*; 2018.

1448. Yamaguchi, K, Tetro, AM, Blam, O, Evanoff, BA, Teefey, SA, Middleton, WD. Natural history of asymptomatic rotator cuff tears: a longitudinal analysis of asymptomatic tears detected sonographically. *J Shoulder Elbow Surg*; 2001.

1449. Barreto, Rodrigo Py Gonçalves, Braman, Jonathan P, Ludewig, Paula M, Ribeiro, Larissa Pechincha, Camargo, Paula Rezende. Bilateral magnetic resonance imaging findings in individuals with unilateral shoulder pain. *Journal of shoulder and elbow surgery*; 2019.

1450. Ostor, A. J., Richards, C. A., Tytherleigh-Strong, G., Bearcroft, P. W., Prevost, A. T., Speed, C. A., Hazleman, B. L. Validation of clinical examination versus magnetic resonance imaging and arthroscopy for the detection of rotator cuff lesions. *Clin Rheumatol*; Sep 2013.

1451. Brockmeyer, M., Schmitt, C., Haupert, A., Kohn, D., Lorbach, O. Limited diagnostic accuracy of magnetic resonance imaging and clinical tests for detecting partial-thickness tears of the rotator cuff. *Arch Orthop Trauma Surg*; Dec 2017.

1452. Desjardins-Charbonneau, Ariel, Roy, Jean-Sébastien, Dionne, Clermont E, Frémont, Pierre, MacDermid, Joy C, Desmeules, François. The efficacy of manual therapy for rotator cuff tendinopathy: a systematic review and meta-analysis. *journal of orthopaedic & sports physical therapy*; 2015.

1453. Chang, C. Y., Wang, S. F., Chiou, H. J., Ma, H. L., Sun, Y. C., Wu, H. D. Comparison of shoulder ultrasound and MR imaging in diagnosing full-thickness rotator cuff tears. *Clin Imaging*; Jan-Feb 2002.

1454. Chingkoe, C. M., White, J. H., Louis, L. J., Andrews, G., Forster, B. B. Rotator cuff troublemakers: pitfalls of MRI and ultrasound. *Open Access J Sports Med*; 2010.

1455. Choo, H. J., Lee, S. J., Kim, O. H., Seo, S. S., Kim, J. H. Comparison of three-dimensional isotropic T1-weighted fast spin-echo MR arthrography with two-dimensional MR arthrography of the shoulder. *Radiology*; Mar 2012.

1456. Cortes, A., Quinlan, N. J., Nazal, M. R., Upadhyaya, S., Alpaugh, K., Martin, S. D. A value-based care analysis of magnetic resonance imaging in patients with suspected rotator cuff tendinopathy and the implicated role of conservative management. *J Shoulder Elbow Surg*; Nov 2019.

1457. de Jesus, J. O., Parker, L., Frangos, A. J., Nazarian, L. N. Accuracy of MRI, MR arthrography, and ultrasound in the diagnosis of rotator cuff tears: a meta-analysis. *AJR Am J Roentgenol*; Jun 2009.

1458. Diehr, S., Ison, D., Jamieson, B., Oh, R. Clinical inquiries. What is the best way to diagnose a suspected rotator cuff tear? *J Fam Pract*; Jul 2006.

1459. Frei, R., Chladek, P., Trc, T., Kopecny, Z., Kautzner, J. Arthroscopic evaluation of ultrasonography and magnetic resonance imaging for diagnosis of rotator cuff tear. *Ortop Traumatol Rehabil*; Mar-Apr 2008.

1460. Furukawa, R., Morihara, T., Arai, Y., Ito, H., Kida, Y., Sukenari, T., Horii, M., Ikoma, K., Fujiwara, H., Kubo, T. Diagnostic accuracy of magnetic resonance imaging for subscapularis tendon tears using radial-slice magnetic resonance images. *J Shoulder Elbow Surg*; Nov 2014.

1461. Hitachi, S., Takase, K., Tanaka, M., Tojo, Y., Tabata, S., Majima, K., Higano, S., Takahashi, S. High-resolution magnetic resonance imaging of rotator cuff tears using a microscopy coil: noninvasive detection without intraarticular contrast material. *Jpn J Radiol*; Aug 2011.

1462. Hodler, J., Kursunoglu-Brahme, S., Snyder, S. J., Cervilla, V., Karzel, R. P., Schweitzer, M. E., Flannigan, B. D., Resnick, D. Rotator cuff disease: assessment with MR arthrography versus standard MR imaging in 36 patients with arthroscopic confirmation. *Radiology*; Feb 1992.

1463. Honda, H., Morihara, T., Arai, Y., Horii, M., Ito, H., Furukawa, R., Kida, Y., Sukenari, T., Ikoma, K., Oda, R., Yamada, Y., Fujiwara, H., Kubo, T. Clinical application of radial magnetic resonance imaging for evaluation of rotator cuff tear. *Orthop Traumatol Surg Res*; Oct 2015.

1464. Huang, T., Liu, J., Ma, Y., Zhou, D., Chen, L., Liu, F. Diagnostic accuracy of MRA and MRI for the bursal-sided partial-thickness rotator cuff tears: a meta-analysis. *J Orthop Surg Res*; Dec 12 2019.

1465. Iannotti, J. P., Zlatkin, M. B., Esterhai, J. L., Kressel, H. Y., Dalinka, M. K., Spindler, K. P. Magnetic resonance imaging of the shoulder. Sensitivity, specificity, and predictive value. *J Bone Joint Surg Am*; Jan 1991.

1466. Jain, N. B., Collins, J., Newman, J. S., Katz, J. N., Losina, E., Higgins, L. D. Reliability of magnetic resonance imaging assessment of rotator cuff: the ROW study. *Pm r*; Mar 2015.

1467. Kelly, A. M., Fessell, D. Ultrasound compared with magnetic resonance imaging for the diagnosis of rotator cuff tears: a critically appraised topic. *Semin Roentgenol*; Jul 2009.

1468. Kim, H. J., Park, J. S., Kim, J. Y., Kee, Y. M., Rhee, Y. G. Interstitial tears of the rotator cuff: difficulty in preoperative diagnosis. *J Shoulder Elbow Surg*; Mar 2018.

1469. Krief, O. P., Huguet, D. Shoulder pain and disability: comparison with MR findings. *AJR Am J Roentgenol*; May 2006.

1470. Malavolta, E. A., Assuncao, J. H., Gracitelli, M. E. C., Yen, T. K., Bordalo-Rodrigues, M., Ferreira Neto, A. A. Accuracy of magnetic resonance imaging (MRI) for subscapularis tear: a systematic review and meta-analysis of diagnostic studies. *Arch Orthop Trauma Surg*; May 2019.

1471. Mohtasib, R. S., Alzahrani, A. M., Asiri, Y. N., Rayes, Z. F., Alshaalan, M. A. Accuracy of shoulder ultrasound examination for diagnosis of rotator cuff pathologies: a single-center retrospective study. *Ann Saudi Med*; May-Jun 2019.

1472. Morag, Y., Jacobson, J. A., Miller, B., De Maeseneer, M., Girish, G., Jamadar, D. MR imaging of rotator cuff injury: what the clinician needs to know. *Radiographics*; Jul-Aug 2006.

1473. Morrison, D. S., Ofstein, R. The use of magnetic resonance imaging in the diagnosis of rotator cuff tears. *Orthopedics*; Jun 1990.

1474. Murakami, A. M., Kompel, A. J., Engebretsen, L., Li, X., Forster, B. B., Crema, M. D., Hayashi, D., Jarraya, M., Roemer, F. W., Guermazi, A. The epidemiology of MRI detected shoulder injuries in athletes participating in the Rio de Janeiro 2016 Summer Olympics. *BMC Musculoskelet Disord*; Aug 17 2018.

1475. Reynolds, A. Imaging the injured shoulder. *Radiol Technol*; Jan-Feb 2012.

1476. Roy, J. S., Braen, C., Leblond, J., Desmeules, F., Dionne, C. E., MacDermid, J. C., Bureau, N. J., Fremont, P. Diagnostic accuracy of ultrasonography, MRI and MR arthrography in the characterisation of rotator cuff disorders: a systematic review and meta-analysis. *Br J Sports Med*; Oct 2015.

1477. Rutten, M. J., Spaargaren, G. J., van Loon, T., de Waal Malefijt, M. C., Kiemeney, L. A., Jager, G. J. Detection of rotator cuff tears: the value of MRI following ultrasound. *Eur Radiol*; Feb 2010.

1478. Sershon, R. A., Mather, R. C., Sherman, S. L., McGill, K. C., Romeo, A. A., Verma, N. N. Low accuracy of interpretation of rotator cuff MRI in patients with osteoarthritis. *Acta Orthop*; Oct 2013.

1479. Smith, T. O., Daniell, H., Geere, J. A., Toms, A. P., Hing, C. B. The diagnostic accuracy of MRI for the detection of partial- and full-thickness rotator cuff tears in adults. *Magn Reson Imaging*; Apr 2012.

1480. Tirman, P. F., Steinbach, L. S., Belzer, J. P., Bost, F. W. A practical approach to imaging of the shoulder with emphasis on MR imaging. *Orthop Clin North Am*; Oct 1997.

1481. Vasishta, A., Kelkar, A., Joshi, P., Hapse, R. The value of sonoelastography in the diagnosis of supraspinatus tendinopathy-a comparison study. *Br J Radiol*; Mar 2019.

1482. Villafane, J. H., Valdes, K., Anselmi, F., Pirali, C., Negrini, S. The diagnostic accuracy of five tests for diagnosing partial-thickness tears of the supraspinatus tendon: A cohort study. *J Hand Ther*; Jul-Sep 2015.

1483. Vinson, E. N., Wittstein, J., Garrigues, G. E., Taylor, D. C. MRI of selected abnormalities at the anterior superior aspect of the shoulder: potential pitfalls and subtle diagnoses. *AJR Am J Roentgenol*; Sep 2012.

1484. Zlatkin, M. B., Falchook, F. S. Magnetic resonance pathology of the rotator cuff. *Top Magn Reson Imaging*; Spring 1994.

1485. Bang, M. D., Deyle, G. D. Comparison of supervised exercise with and without manual physical therapy for patients with shoulder impingement syndrome. *J Orthop Sports Phys Ther*; Mar 2000.

1486. Green, S., Buchbinder, R, Hetrick, S. Physiotherapy interventions for shoulder pain. *Cochrane Database Syst Rev*; 2006.

1487. Teys, P., Bisset, L., Vicenzino, B. The initial effects of a Mulligan's mobilization with movement technique on range of movement and pressure pain threshold in pain-limited shoulders. *Man Ther*; Feb 2008.

1488. Trampas, A., Kitsios, A. Exercise and manual therapy for the treatment of impingement syndrome of the shoulder: a systematic review. *Physical Therapy Reviews*; 2006.

1489. Ho, C. Y., Sole, G., Munn, J. The effectiveness of manual therapy in the management of musculoskeletal disorders of the shoulder: a systematic review. *Man Ther*; Oct 2009.

1490. Desmeules, F., Cote, C. H., Fremont, P. Therapeutic exercise and orthopedic manual therapy for impingement syndrome: a systematic review. *Clin J Sport Med*; May 2003.

1491. Senbursa, G., Baltaci, G., Atay, A. Comparison of conservative treatment with and without manual physical therapy for patients with shoulder impingement syndrome: a prospective, randomized clinical trial. *Knee Surg Sports Traumatol Arthrosc*; Jul 2007.

1492. Citaker, S, Taskiran, H, Akdur, H, Arabaci, UO, Ekici, G. Comparison of the mobilization and proprioceptive neuromuscular facilitation methods in the treatment of shoulder impingement sydrome. *Pain Clin*; 2005.

1493. Conroy, D. E., Hayes, K. W. The effect of joint mobilization as a component of comprehensive treatment for primary shoulder impingement syndrome. *J Orthop Sports Phys Ther*; Jul 1998.

1494. Boyles, R. E., Ritland, B. M., Miracle, B. M., Barclay, D. M., Faul, M. S., Moore, J. H., Koppenhaver, S. L., Wainner, R. S. The short-term effects of thoracic spine thrust manipulation on patients with shoulder impingement syndrome. *Manual Therapy*; 08 2009.

1495. Kim, Y.-S.,et al. Is early passive motion exercise necessary after arthroscopic rotator cuff repair? *The American journal of sports medicine*; 2012.

1496. De, P.R.,et al. Passive mobilization after arthroscopic rotator cuff repair is not detrimental in the early postoperative period. *Acta Orthopaedica Belgica*; 2015.

1497. Gomes, Cafp, Dibai-Filho, A. V., Politti, F., Gonzalez, T. O., Biasotto-Gonzalez, D. A. Combined Use of Diadynamic Currents and Manual Therapy on Myofascial Trigger Points in Patients With Shoulder Impingement Syndrome: A Randomized Controlled Trial. *J Manipulative Physiol Ther*; Jul-Aug 2018.

1498. Pragassame, S Arul, Kurup, VK Mohandas. Efficacy of limited treatment frequency of Mulligan's mobilization with movement for frozen shoulder. *Indian Journal of Physiotherapy and Occupational Therapy*; 2014.

1499. Aytar, Aydan, Baltaci, Gul, Uhl, Tim, Tuzun, Handan, Oztop, Pinar, Karatas, Metin. The effects of scapular mobilization in patients with subacromial impingement syndrome: a randomized, double-blind, placebo-controlled clinical trial. *Journal of sport rehabilitation*; 2015.

1500. Beaudreuil, J,et al. Effect of dynamic humeral centring (DHC) treatment on painful active elevation of the arm in subacromial impingement syndrome. Secondary analysis of data from an RCT. *Br J Sports Med*; 2015.

1501. Beaudreuil, J,et al. Assessment of dynamic humeral centering in shoulder pain with impingement syndrome: a randomised clinical trial. *Annals of the Rheumatic Diseases*; 2011.

1502. Bizzarri, Paolo, Buzzatti, Luca, Cattrysse, Erik, Scafoglieri, Aldo. Thoracic manual therapy is not more effective than placebo thoracic manual therapy in patients with shoulder dysfunctions: A systematic review with meta-analysis. *Musculoskeletal Science and Practice*; 2018.

1503. Bury, Julie, West, Morgan, Chamorro-Moriana, Gema, Littlewood, Chris. Effectiveness of scapula-focused approaches in patients with rotator cuff related shoulder pain: a systematic review and meta-analysis. *Manual therapy*; 2016.

1504. Camarinos, James, Marinko, Lee. Effectiveness of manual physical therapy for painful shoulder conditions: a systematic review. *Journal of Manual & Manipulative Therapy*; 2009.

1505. Cook, C,et al. The addition of cervical unilateral posterior–anterior mobilisation in the treatment of patients with shoulder impingement syndrome: a randomised clinical trial. *Manual Therapy*; 2014.

1506. de Paula Gomes, CAF,et al. Combined use of diadynamic currents and manual therapy on myofascial trigger points in patients with shoulder impingement syndrome: a randomized controlled trial. *Journal of Manipulative and Physiological Therapeutics*; 2018.

1507. Delgado-Gil, JA,et al. Effects of mobilization with movement on pain and range of motion in patients with unilateral shoulder impingement syndrome: a randomized controlled trial. *Journal of Manipulative and Physiological Therapeutics*; 2015.

1508. Gebremariam, L., Hay, E. M., van der Sande, R., Rinkel, W. D., Koes, B. W., Huisstede, B. M. Subacromial impingement syndrome--effectiveness of physiotherapy and manual therapy. *Br J Sports Med*; Aug 2014.

1509. Haik, Melina N, Alburquerque-Sendín, Francisco, Camargo, Paula R. Short-term effects of thoracic spine manipulation on shoulder impingement syndrome: a randomized controlled trial. *Archives of physical medicine and rehabilitation*; 2017.

1510. Haik, MN,et al. Scapular kinematics pre–and post–thoracic thrust manipulation in individuals with and without shoulder impingement symptoms: a randomized controlled stud. *Journal of Orthopaedic & Sports Physical Therapy*; 2014.

1511. Hauswirth J, et al. Immediate effects of cervical unilateral anterior-posterior mobilisation on shoulder pain and impairment in post-operative arthroscopy patients. *Journal of Back and Musculoskeletal Rehabilitation*; 2017.

1512. Kachingwe, AF,et al. Comparison of manual therapy techniques with therapeutic exercise in the treatment of shoulder impingement: a randomized controlled pilot clinical trial. *Journal of Manual and Manipulative Therapy*; 2008.

1513. Kardouni, Joseph. Effects of Thoracic Spinal Manipulative Therapy on Thoracic Spine and Shoulder Kinematics, Thoracic Spine Flexion/Extension Excursion, and Pressure Pain Sensitivity in Patients with Subacromial Pain Syndrome. 2013.

1514. Kardouni, JR,et al. Thoracic spine manipulation in individuals with subacromial impingement syndrome does not immediately alter thoracic spine kinematics, thoracic excursion, or scapular kinematics: a randomized controlled trial. *Journal of Orthopaedic & Sports Physical Therapy*; 2015.

1515. Kardouni, JR,et al. Immediate changes in pressure pain sensitivity after thoracic spinal manipulative therapy in patients with subacromial impingement syndrome: a randomized controlled study. *Manual Therapy*; 2015.

1516. Keener, Jay D, Galatz, Leesa M, Stobbs-Cucchi, Georgia, Patton, Rebecca, Yamaguchi, Ken. Rehabilitation following arthroscopic rotator cuff repair: a prospective randomized trial of immobilization compared with early motion. *JBJS*; 2014.

1517. Kromer, TO,de Bie,RA,Bastiaenen,CH. Effectiveness of physiotherapy and costs in patients with clinical signs of shoulder impingement syndrome: One-year follow-up of a randomized controlled trial. *Journal of Rehabilitation Medicine,*; 2014.

1518. Land, Helen, Gordon, Susan, Watt, Kerrianne. Effect of manual physiotherapy in homogeneous individuals with subacromial shoulder impingement: A randomized controlled trial. *Physiotherapy Research International*; 2019.

1519. Menek, B,Tarakci,D,Algun,ZC. The effect of Mulligan mobilization on pain and life quality of patients with Rotator cuff syndrome: A randomized controlled trial. *Journal of Back and Musculoskeletal Rehabilitation*; 2019.

1520. Michener LA, et al. Validation of a sham comparator for thoracic spinal manipulation in patients with shoulder pain. *Manual Therapy*; 2015.

1521. Muth, Stephanie, Barbe, Mary F, Lauer, Richard, McClure, Philip. The effects of thoracic spine manipulation in subjects with signs of rotator cuff tendinopathy. *journal of orthopaedic & sports physical therapy*; 2012.

1522. Riley, SP,et al. Thoracic spinal manipulation for musculoskeletal shoulder pain: Can an instructional set change patient expectation and outcome? *Manual Therapy*; 2015.

1523. Riley, SP,et al. Short-term effects of thoracic spinal manipulations and message conveyed by clinicians to patients with musculoskeletal shoulder symptoms: a randomized clinical trial. *Journal of Manual & Manipulative Therapy*; 2015.

1524. Satpute, KH,Bhandari,P,and Hall,T. Efficacy of hand behind back mobilization with movement for acute shoulder pain and movement impairment: a randomized controlled trial. *Journal of Manipulative and Physiological Therapeutics*; 2015.

1525. Şenbursa, G,Baltaci,G,Atay,ÖA. The effectiveness of manual therapy in supraspinatus tendinopathy. *Acta Orthopaedica et Traumatologica Turcica*; 2011.

1526. Sheps, D,et al. Early mobilisation following mini-open rotator cuff repair: a randomised control trial. *The Bone and Joint Journal*; 2015.

1527. Steuri, Ruedi, Sattelmayer, Martin, Elsig, Simone, Kolly, Chloé, Tal, Amir, Taeymans, Jan, Hilfiker, Roger. Effectiveness of conservative interventions including exercise, manual therapy and medical management in adults with shoulder impingement: a systematic review and meta-analysis of RCTs. *Br J Sports Med*; 2017.

1528. Surenkok, O,Aytar,A,Baltaci G. Acute effects of scapular mobilization in shoulder dysfunction: a double-blind randomized placebo-controlled trial. *Journal of Sport Rehabilitation*; 2009.

1529. Teys, P,et al. One-week time course of the effects of Mulligan's Mobilisation with Movement and taping in painful shoulders. *Manual Therapy*; 2013.

1530. van Rensburg, KJ,Atkins,E. Does thoracic manipulation increase shoulder range of movement in patients with subacromial impingement syndrome? A pilot study. *International Musculoskeletal Medicine*; 2012.

1531. Witt, Dexter W, Talbott, Nancy R. The effect of shoulder position on inferior glenohumeral mobilization. *Journal of Hand Therapy*; 2018.

1532. Wright AA, et al. Subacute effects of cervicothoracic spinal thrust/non-thrust in addition to shoulder manual therapy plus exercise intervention in individuals with subacromial impingement syndrome: a prospective, randomized controlled clinical trial pilot study. *Journal of Manual & Manipulative Therapy*; 2017.

1533. Perlick, L., Luring, C., Bathis, H., Perlick, C., Kraft, C., Diedrich, O. Efficacy of extracorporal shock-wave treatment for calcific tendinitis of the shoulder: experimental and clinical results. *J Orthop Sci*; 2003.

1534. Mouzopoulos, G., Stamatakos, M., Mouzopoulos, D., Tzurbakis, M. Extracorporeal shock wave treatment for shoulder calcific tendonitis: a systematic review. *Skeletal Radiol*; Sep 2007.

1535. Rompe, J. D., Burger, R., Hopf, C., Eysel, P. Shoulder function after extracorporal shock wave therapy for calcific tendinitis. *J Shoulder Elbow Surg*; Sep-Oct 1998.

1536. Rompe, J. D., Zoellner, J., Nafe, B. Shock wave therapy versus conventional surgery in the treatment of calcifying tendinitis of the shoulder. *Clin Orthop Relat Res*; Jun 2001.

1537. Sems, A., Dimeff, R., Iannotti, J. P. Extracorporeal shock wave therapy in the treatment of chronic tendinopathies. *J Am Acad Orthop Surg*; Apr 2006.

1538. Chung, B., Wiley, J. P. Extracorporeal shockwave therapy: a review. *Sports Med*; 2002.

1539. Loew, M., Daecke, W., Kusnierczak, D., Rahmanzadeh, M., Ewerbeck, V. Shock-wave therapy is effective for chronic calcifying tendinitis of the shoulder. *J Bone Joint Surg Br*; Sep 1999.

1540. Cosentino, R., De Stefano, R., Selvi, E., Frati, E., Manca, S., Frediani, B., Marcolongo, R. Extracorporeal shock wave therapy for chronic calcific tendinitis of the shoulder: single blind study. *Ann Rheum Dis*; Mar 2003.

1541. Ioppolo, F., Tattoli, M., Di Sante, L., Venditto, T., Tognolo, L., Delicata, M., Rizzo, R. S., Di Tanna, G., Santilli, V. Clinical improvement and resorption of calcifications in calcific tendinitis of the shoulder after shock wave therapy at 6 months' follow-up: a systematic review and meta-analysis. *Arch Phys Med Rehabil*; Sep 2013.

1542. Frassanito, P.,et al. Effectiveness of Extracorporeal Shock Wave Therapy and kinesio taping in calcific tendinopathy of the shoulder: a randomized controlled trial. *European journal of physical and rehabilitation medicine*; 2018.

1543. Brañes, J.,et al. Shoulder rotator cuff responses to extracorporeal shockwave therapy: morphological and immunohistochemical analysis. *Shoulder & Elbow*; 2012.

1544. Carlisi, E.,et al. Focused extracorporeal shock wave therapy combined with supervised eccentric training for supraspinatus calcific tendinopathy. *European journal of physical and rehabilitation medicine*; 2018.

1545. Carulli C, et al. Effectiveness of extracorporeal shockwave therapy in three major tendon diseases. *Journal of Orthopaedics and Traumatology*; 2016.

1546. Chou, W.,et al. Prognostic factors for the outcome of extracorporeal shockwave therapy for calcific tendinitis of the shoulder. *The bone & joint journal*; 2017.

1547. Chou W-Y, et al. Comparative outcomes of extracorporeal shockwave therapy for shoulder tendinitis or partial tears of the rotator cuff in athletes and non-athletes: Retrospective study. *International Journal of Surgery*; 2018.

1548. Engebretsen, K., Grotle, M., Bautz-Holter, E., Ekeberg, O. M., Juel, N. G., Brox, J. I. Supervised exercises compared with radial extracorporeal shock-wave therapy for subacromial shoulder pain: 1-year results of a single-blind randomized controlled trial. *Phys Ther*; Jan 2011.

1549. Farr S, et al. Extracorporeal shockwave therapy in calcifying tendinitis of the shoulder. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2011.

1550. Frizziero A, et al. Extracorporeal shockwaves therapy versus hyaluronic acid injection for the treatment of painful non-calcific rotator cuff tendinopathies: preliminary results. *The Journal of sports medicine and physical fitness*; 2017.

1551. Kvalvaag, E. One year results of a randomized controlled trial on radial Extracorporeal Shock Wave Treatment, with predictors of pain, disability and return to work in patients with subacromial pain syndrome. *European journal of physical and rehabilitation medicine*; 2017.

1552. Kvalvaag, E.,et al. Effectiveness of radial extracorporeal shock wave therapy (rESWT) when combined with supervised exercises in patients with subacromial shoulder pain: a double-masked, randomized, sham-controlled trial. *American journal of sports medicine*; 2017.

1553. Lorbach O, et al. Influence of deposit stage and failed ESWT on the surgical results of arthroscopic treatment of calcifying tendonitis of the shoulder. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2008.

1554. Malliaropoulos N, et al. Individualised radial extracorporeal shock wave therapy (rESWT) for symptomatic calcific shoulder tendinopathy: a retrospective clinical study. *BMC musculoskeletal disorders*; 2017.

1555. Moretti B, et al. Medium-energy shock wave therapy in the treatment of rotator cuff calcifying tendinitis. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2005.

1556. Ramon S, et al. Is hyaluronic injection really better than shockwave treatment for painful non-calcified rotator cuff tendinopathies? Think again…. *The Journal of sports medicine and physical fitness*; 2018.

1557. Rebuzzi E, et al. Arthroscopy surgery versus shock wave therapy for chronic calcifying tendinitis of the shoulder. *Journal of Orthopaedics and Traumatology*; 2008.

1558. Santamato A, et al. Is extracorporeal shockwave therapy combined with isokinetic exercise more effective than extracorporeal shockwave therapy alone for subacromial impingement syndrome? A randomized clinical trial. *Journal of Orthopaedic &; Sports Physical Therapy*; 2016.

1559. Speed, C. Extracorporeal shock-wave therapy in the management of chronic soft-tissue conditions. *Journal of bone and joint surgery. British volume*; 2004.

1560. Surace SJ, et al. Shock wave therapy for rotator cuff disease with or without calcification. *Cochrane Database of Systematic Reviews*; 2020.

1561. Wijayanti I, et al. Comparing the effectiveness of medium-and high-dose extracorporeal shockwave therapy against calcific tendonitis of the rotator cuff. *Journal of Physics: Conference Series*; 2018.

1562. Wu K-T, et al. Efficacy of Extracorporeal Shockwave Therapy on Calcified and Noncalcified Shoulder Tendinosis: A Propensity Score Matched Analysis. *BioMed research international*; 2019.

1563. Post, M, J, Cohen. Impingement syndrome. A review of late stage II and early stage III lesions. *Clinical orthopaedics and related research*; 1986.

1564. Ellman, H. Arthroscopic subacromial decompression: analysis of one- to three-year results. *Arthroscopy*; 1987.

1565. Budoff, J. E., Rodin, D., Ochiai, D., Nirschl, R. P. Arthroscopic rotator cuff debridement without decompression for the treatment of tendinosis. *Arthroscopy*; Sep 2005.

1566. Checroun, A. J., Dennis, M. G., Zuckerman, J. D. Open versus arthroscopic decompression for subacromial impingement. A comprehensive review of the literature from the last 25 years. *Bull Hosp Jt Dis*; 1998.

1567. Schroder, J., van Dijk, C. N., Wielinga, A., Kerkhoffs, G. M., Marti, R. K. Open versus arthroscopic treatment of chronic rotator cuff impingement. *Arch Orthop Trauma Surg*; May 2001.

1568. Hawkins, R. J., Brock, R. M., Abrams, J. S., Hobeika, P. Acromioplasty for impingement with an intact rotator cuff. *J Bone Joint Surg Br*; Nov 1988.

1569. Coghlan, J. A., Forbes, A., McKenzie, D., Bell, S. N., Buchbinder, R. Efficacy of subacromial ropivacaine infusion for rotator cuff surgery. A randomized trial. *J Bone Joint Surg Am*; Jul 2009.

1570. Ingvarsson, T., Hagglund, G., Johnsson, R. Anterior acromioplasty. A comparison of two techniques. *Int Orthop*; 1996.

1571. Dorrestijn, O., Stevens, M., Winters, J. C., van der Meer, K., Diercks, R. L. Conservative or surgical treatment for subacromial impingement syndrome? A systematic review. *J Shoulder Elbow Surg*; Jul-Aug 2009.

1572. Kempf, J. F., Gleyze, P., Bonnomet, F., Walch, G., Mole, D., Frank, A., Beaufils, P., Levigne, C., Rio, B., Jaffe, A. A multicenter study of 210 rotator cuff tears treated by arthroscopic acromioplasty. *Arthroscopy*; Jan-Feb 1999.

1573. Ellman, H., Kay, S. P. Arthroscopic subacromial decompression for chronic impingement. Two- to five-year results. *J Bone Joint Surg Br*; May 1991.

1574. Altchek, D. W., Warren, R. F., Wickiewicz, T. L., Skyhar, M. J., Ortiz, G., Schwartz, E. Arthroscopic acromioplasty. Technique and results. *J Bone Joint Surg Am*; Sep 1990.

1575. Gartsman, GM. Arthroscopic acromioplasty for lesions of the rotator cuff. *J Bone Joint Surg Am*; 1990.

1576. Paulos, L. E., Franklin, J. L. Arthroscopic shoulder decompression development and application. A five year experience. *Am J Sports Med*; May-Jun 1990.

1577. Boult, M., Wicks, M., Watson, D. I., MacDougal, G., Shimmin, A., Maddern, G. J. Arthroscopic subacromial decompression with a holmium:YAG laser: review of the literature. *ANZ J Surg*; Mar 2001.

1578. Speer, K. P., Lohnes, J., Garrett, W. E.,Jr. Arthroscopic subacromial decompression: results in advanced impingement syndrome. *Arthroscopy*; 1991.

1579. Rahme, H., Solem-Bertoft, E., Westerberg, C. E., Lundberg, E., Sorensen, S., Hilding, S. The subacromial impingement syndrome. A study of results of treatment with special emphasis on predictive factors and pain-generating mechanisms. *Scand J Rehabil Med*; Dec 1998.

1580. Haahr, J. P., Ostergaard, S., Dalsgaard, J., Norup, K., Frost, P., Lausen, S., Holm, E. A., Andersen, J. H. Exercises versus arthroscopic decompression in patients with subacromial impingement: a randomised, controlled study in 90 cases with a one year follow up. *Ann Rheum Dis*; May 2005.

1581. Brox, J. I., Staff, P. H., Ljunggren, A. E., Brevik, J. I. Arthroscopic surgery compared with supervised exercises in patients with rotator cuff disease (stage II impingement syndrome). *Br Med J*; Oct 9 1993.

1582. T'Jonck, L., Lysens, R., De Smet, L., Bellemans, J., Stoffelen, D., Tirez, B., Witvrouw, E. Open versus arthroscopic subacromial decompression: analysis of one-year results. *Physiother Res Int*; 1997.

1583. Lindh, M., Norlin, R. Arthroscopic subacromial decompression versus open acromioplasty. A two-year follow-up study. *Clin Orthop Relat Res*; May 1993.

1584. Brox, J. I., Gjengedal, E., Uppheim, G., Bohmer, A. S., Brevik, J. I., Ljunggren, A. E., Staff, P. H. Arthroscopic surgery versus supervised exercises in patients with rotator cuff disease (stage II impingement syndrome): a prospective, randomized, controlled study in 125 patients with a 2 1/2-year follow-up. *J Shoulder Elbow Surg*; Mar-Apr 1999.

1585. Husby, T., Haugstvedt, J. R., Brandt, M., Holm, I., Steen, H. Open versus arthroscopic subacromial decompression: a prospective, randomized study of 34 patients followed for 8 years. *Acta Orthop Scand*; Aug 2003.

1586. Haahr, J. P., Andersen, J. H. Exercises may be as efficient as subacromial decompression in patients with subacromial stage II impingement: 4-8-years' follow-up in a prospective, randomized study. *Scand J Rheumatol*; May-Jun 2006.

1587. Sachs, R. A., Stone, M. L., Devine, S. Open vs. arthroscopic acromioplasty: a prospective, randomized study. *Arthroscopy*; Jun 1994.

1588. Odenbring, S., Wagner, P., Atroshi, I. Long-term outcomes of arthroscopic acromioplasty for chronic shoulder impingement syndrome: a prospective cohort study with a minimum of 12 years' follow-up. *Arthroscopy*; Oct 2008.

1589. Kukkonen, J, Joukainen, A, Lehtinen, J, Mattila, KT, Tuominen, EKJ, Kauko, T, Äärimaa, V. Treatment of non-traumatic rotator cuff tears: A randomised controlled trial with one-year clinical results. *The bone & joint journal*; 2014.

1590. Carr, Andrew J, Murphy, Richard, Dakin, Stephanie G, Rombach, Ines, Wheway, Kim, Watkins, Bridget, Franklin, Sarah L. Platelet-rich plasma injection with arthroscopic acromioplasty for chronic rotator cuff tendinopathy: a randomized controlled trial. *The American journal of sports medicine*; 2015.

1591. Chahal, J., Mall, N., MacDonald, P. B., Van Thiel, G., Cole, B. J., Romeo, A. A., Verma, N. N. The role of subacromial decompression in patients undergoing arthroscopic repair of full-thickness tears of the rotator cuff: a systematic review and meta-analysis. *Arthroscopy*; May 2012.

1592. Farfaras, Stefanos, Sernert, Ninni, Hallström, Erling, Kartus, Jüri. Comparison of open acromioplasty, arthroscopic acromioplasty and physiotherapy in patients with subacromial impingement syndrome: a prospective randomised study. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2016.

1593. Farfaras, Stefanos, Sernert, Ninni, Rostgard Christensen, Lars, Hallström, Erling K, Kartus, Jüri-Toomas. Subacromial decompression yields a better clinical outcome than therapy alone: a prospective randomized study of patients with a minimum 10-year follow-up. *The American journal of sports medicine*; 2018.

1594. Kolk, Arjen, Thomassen, Bregje JW, Hund, Hajo, de Witte, Pieter Bas, Henkus, Hans-Erik, Wassenaar, Willem G, van Arkel, Ewoud RA, Nelissen, Rob GHH. Does acromioplasty result in favorable clinical and radiologic outcomes in the management of chronic subacromial pain syndrome? A double-blinded randomized clinical trial with 9 to 14 years' follow-up. *Journal of shoulder and elbow surgery*; 2017.

1595. MacDonald, P., McRae, S., Leiter, J., Mascarenhas, R., Lapner, P. Arthroscopic rotator cuff repair with and without acromioplasty in the treatment of full-thickness rotator cuff tears: a multicenter, randomized controlled trial. *J Bone Joint Surg Am*; Nov 2 2011.

1596. Shin, Sang-Jin, Oh, Joo Han, Chung, Seok Won, Song, Mi Hyun. The efficacy of acromioplasty in the arthroscopic repair of small-to medium-sized rotator cuff tears without acromial spur: prospective comparative study. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2012.

1597. Bengtsson, Marie, Lunsjö, Karl, Hermodsson, Ylva, Nordqvist, Anders, Abu-Zidan, Fikri M. High patient satisfaction after arthroscopic subacromial decompression for shoulder impingement: a prospective study of 50 patients. *Acta orthopaedica*; 2006.

1598. Bhattacharyya, Rahul, Edwards, Kimberley, Wallace, Angus W. Does arthroscopic sub-acromial decompression really work for sub-acromial impingement syndrome: a cohort study. *BMC musculoskeletal disorders*; 2014.

1599. Biberthaler, Peter, Beirer, Marc, Kirchhoff, Sonja, Braunstein, Volker, Wiedemann, Ernst, Kirchhoff, Chlodwig. Significant benefit for older patients after arthroscopic subacromial decompression: a long-term follow-up study. *International orthopaedics*; 2013.

1600. Butt, U, Whiteman, A, Wilson, J, Paul, E, Roy, B. Does arthroscopic subacromial decompression improve quality of life. *The annals of the royal college of surgeons of England*; 2015.

1601. Dong, Wei, Goost, Hans, Lin, Xiang-Bo, Burger, Christof, Paul, Christian, Wang, Zeng-Li, Zhang, Tian-Yi, Jiang, Zhi-Chao, Welle, Kristian, Kabir, Koroush. Treatments for shoulder impingement syndrome: a PRISMA systematic review and network meta-analysis. *Medicine*; 2015.

1602. Donigan, Jonathan A, Wolf, Brian R. Arthroscopic subacromial decompression: acromioplasty versus bursectomy alone-does it really matter? A systematic review. *The Iowa orthopaedic journal*; 2011.

1603. Ketola, Saara, Lehtinen, Janne, Elo, Petra, Kortelainen, Seppo, Huhtala, Heini, Arnala, Ilkka. No difference in long-term development of rotator cuff rupture and muscle volumes in impingement patients with or without decompression: a randomized MRI study of 140 patients. *Acta orthopaedica*; 2016.

1604. Nutton, Richard W, Mcbirnie, Julie M, Phillips, Christine. Treatment of chronic rotator-cuff impingement by arthroscopic subacromial decompression. *The Journal of bone and joint surgery. British volume*; 1997.

1605. Viner, Gean C, He, Jun Kit, Brabston, Eugene W, Momaya, Amit, Ponce, Brent A. Os acromiale: systematic review of surgical outcomes. *Journal of Shoulder and Elbow Surgery*; 2020.

1606. Franceschi, F,et al. To detach the long head of the biceps tendon after tenodesis or not: outcome analysis at the 4-year follow-up of two different techniques. *International Orthopaedics*; 2007.

1607. Koh, K.H.,et al. Treatment of biceps tendon lesions in the setting of rotator cuff tears: prospective cohort study of tenotomy versus tenodesis. *American journal of sports medicine*; 2010.

1608. Abraham, Vineet Thomas, Tan, Bryan HM, Kumar, V Prem. Systematic review of biceps tenodesis: arthroscopic versus open. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2016.

1609. Aflatooni, Justin O, Meeks, Brett D, Froehle, Andrew W, Bonner, Kevin F. Biceps tenotomy versus tenodesis: patient-reported outcomes and satisfaction. *Journal of Orthopaedic Surgery and Research*; 2020.

1610. Baumgarten, Keith M, Chang, Peter S, Foley, Elaine K. Patient-determined outcomes after arthroscopic rotator cuff repair with and without biceps tenodesis utilizing the PITT technique. *Journal of shoulder and elbow surgery*; 2019.

1611. Bayle, Xavier, Pham, Thuy-Trang, Faruch, Marie, Gobet, Aurelie, Mansat, Pierre, Bonnevialle, Nicolas. No difference in outcome for open versus arthroscopic rotator cuff repair: a prospective comparative trial. *Archives of orthopaedic and trauma surgery*; 2017.

1612. Belay, Elshaday S, Wittstein, Jocelyn R, Garrigues, Grant E, Lassiter, Tally E, Scribani, Melissa, Goldner, Richard D, Bean, Christopher A. Biceps tenotomy has earlier pain relief compared to biceps tenodesis: a randomized prospective study. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2019.

1613. Biz, Carlo, Vinanti, Giovanni Battista, Rossato, Alberto, Arnaldi, Enrico, Aldegheri, Roberto. Prospective study of three surgical procedures for long head biceps tendinopathy associated with rotator cuff tears. *Muscles, ligaments and tendons journal*; 2012.

1614. Boileau, Pascal, Baqué, François, Valerio, Laure, Ahrens, Philip, Chuinard, Christopher, Trojani, Christophe. Isolated arthroscopic biceps tenotomy or tenodesis improves symptoms in patients with massive irreparable rotator cuff tears. *JBJS*; 2007.

1615. Castricini, R.,et al. Tenodesis is not superior to tenotomy in the treatment of the long head of biceps tendon lesions. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2018.

1616. Cavalier, Maxime, Jullion, Stéphane, Kany, Jean, Grimberg, Jean, Lefebvre, Yves, Oudet, Didier, Grosclaude, Sophie, Charousset, Christophe, Boileau, Pascal, Joudet, Thierry. Management of massive rotator cuff tears: prospective study in 218 patients. *Orthopaedics & Traumatology: Surgery & Research*; 2018.

1617. Chalmers, Peter N, Monson, Brett, Frank, Rachel M, Mascarenhas, Randy, Nicholson, Gregory P, Bach, Bernard R, Verma, Nikhil N, Cole, Brian J, Romeo, Anthony A. Combined SLAP repair and biceps tenodesis for superior labral anterior–posterior tears. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2016.

1618. Cho, Nam Su, Cha, Sang Won, Rhee, Yong Girl. Funnel tenotomy versus intracuff tenodesis for lesions of the long head of the biceps tendon associated with rotator cuff tears. *The American Journal of Sports Medicine*; 2014.

1619. Çinar, B Murat, Tuncay, Cengiz. Clinical and isokinetic comparison between tenotomy and tenodesis in biceps pathologies. *Acta Orthop Traumatol Turc*; 2011.

1620. Clement, X, Baldairon, F, Clavert, P, Kempf, J-F. Popeye sign: Tenodesis vs. self-locking “T” tenotomy of the long head of the biceps. *Orthopaedics & Traumatology: Surgery & Research*; 2018.

1621. Cvetanovich, Gregory L, Gowd, Anirudh K, Frantz, Travis L, Erickson, Brandon J, Romeo, Anthony A. Superior Labral Anterior Posterior Repair and Biceps Tenodesis Surgery: Trends of the American Board of Orthopaedic Surgery Database. *The American Journal of Sports Medicine*; 2020.

1622. Dwyer, Corey, Kia, Cameron, Apostolakos, John M, DiVenere, Jessica, Dyrna, Felix, Cote, Mark, Arciero, Robert A, Mazzocca, Augustus D. Clinical outcomes after biceps tenodesis or tenotomy using subpectoral pain to guide management in patients with rotator cuff tears. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2019.

1623. Eguia, Francisco A, Ali, Iman, Bansal, Ankit, McFarland, Edward G, Srikumaran, Uma. Minimal clinically important differences after subpectoral biceps tenodesis: definition and retrospective assessment of predictive factors. *Journal of Shoulder and Elbow Surgery*; 2020.

1624. Erickson, Brandon J, Basques, Bryce A, Griffin, Justin W, Taylor, Samuel A, O'Brien, Stephen J, Verma, Nikhil N, Romeo, Anthony A. The effect of concomitant biceps tenodesis on reoperation rates after rotator cuff repair: a review of a large private-payer database from 2007 to 2014. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2017.

1625. Erşen, Ali, Ozben, Hakan, Demirhan, Mehmet, Atalar, Ata Can, Kapıcıoğlu, Mehmet. Time-dependent changes after latissimus dorsi transfer: tenodesis or tendon transfer? *Clinical Orthopaedics and Related Research®*; 2014.

1626. Fang, Jing-hua, Dai, Xue-song, Yu, Xin-ning, Luo, Jian-yang, Liu, Xiao-nan, Zhang, Miao-feng, Zhu, Su-nan. Lesions of the Long Head of the Biceps Tendon Concomitant with Rotator Cuff Tears: Tenotomy or Subpectoral Mini-open Tenodesis? A Comparative Short to Mid-term Follow-up Study. *Orthopaedic surgery*; 2019.

1627. Faruqui, Sami, Kotob, Mohammad A, Hanna, Courtney C, Foad, Abdullah. The modified Norwegian method of biceps tenodesis: how well does it work? *Knee Surgery, Sports Traumatology, Arthroscopy*; 2017.

1628. Forsythe, B,et al. Arthroscopic suprapectoral and open subpectoral biceps tenodeses produce similar outcomes: a randomized prospective analysis. *Journal of Arthroscopic & Related Surgery*; 2020.

1629. Franceschetti, E,et al. The management of the long head of the biceps in rotator cuff repair: A comparative study of high vs. subpectoral tenodesis. *Journal of Sport and Health Science*; 2020.

1630. Glait, Sergio A, Mahure, Siddharth, Loomis, Cynthia A, Cammer, Michael, Pham, Hien, Feldman, Andrew, Jazrawi, Laith M, Strauss, Eric J. Regional histologic differences in the long head of the biceps tendon following subpectoral biceps tenodesis in patients with rotator cuff tears and SLAP lesions. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2018.

1631. Godenèche, Arnaud, Kempf, Jean-François, Nové-Josserand, Laurent, Michelet, Aude, Saffarini, Mo, Hannink, Gerjon, Collin, Philippe. Tenodesis renders better results than tenotomy in repairs of isolated supraspinatus tears with pathologic biceps. *Journal of shoulder and elbow surgery*; 2018.

1632. Gottschalk, Michael B, Karas, Spero G, Ghattas, Timothy N, Burdette, Rachel. Subpectoral biceps tenodesis for the treatment of type II and IV superior labral anterior and posterior lesions. *The American journal of sports medicine*; 2014.

1633. Green, Jamison M, Getelman, Mark H, Snyder, Stephen J, Burns, Joseph P. All-arthroscopic suprapectoral versus open subpectoral tenodesis of the long head of the biceps brachii without the use of interference screws. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2017.

1634. Gurnani, N., van Deurzen, D. F., Janmaat, V. T., van den Bekerom, M. P. Tenotomy or tenodesis for pathology of the long head of the biceps brachii: a systematic review and meta-analysis. *Knee Surg Sports Traumatol Arthrosc*; Dec 2016.

1635. Hufeland, M.,et al. Biceps tenodesis versus tenotomy in isolated LHB lesions: a prospective randomized clinical trial. *Archives of Orthopaedic and Trauma Surgery*; 2019.

1636. Ikemoto, Roberto Yukio, Pileggi, Paulo Eduardo, Murachovsky, Joel, Nascimento, Luís Gustavo Prata, Serpone, Rogerio Bueno, Strose, Eric, Oliveira, Luiz Henrique Almeida. Tenotomy with or without tenodesis of the long head of the biceps using repair of the rotator cuff. *Revista Brasileira de Ortopedia (English Edition)*; 2012.

1637. Jacxsens, Matthijs, Granger, Erin K, Tashjian, Robert Z. Clinical and sonographic evaluation of subpectoral biceps tenodesis with a dual suture anchor technique demonstrates improved outcomes and a low failure rate at a minimum 2-year follow-up. *Archives of Orthopaedic and Trauma Surgery*; 2018.

1638. Kim, Jangwoo, Nam, Ji Hoon, Kim, Yuna, Kim, Jong Seop, Kim, Sae Hoon. Long Head of the Biceps Tendon Tenotomy versus Subpectoral Tenodesis in Rotator Cuff Repair. *Clinics in Orthopedic Surgery*; 2020.

1639. Kooistra, Bauke, Gurnani, Navin, Weening, Alexander, van den Bekerom, Michel, van Deurzen, Derek. Low level of evidence for all treatment modalities for irreparable posterosuperior rotator cuff tears. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2019.

1640. Kukkonen, Juha, Rantakokko, Juho, Virolainen, Petri, Äärimaa, Ville. The effect of biceps procedure on the outcome of rotator cuff reconstruction. *International Scholarly Research Notices*; 2013.

1641. Lee, Hyo-Jin, Jeong, Jin-Young, Kim, Chul-Kyu, Kim, Yang-Soo. Surgical treatment of lesions of the long head of the biceps brachii tendon with rotator cuff tear: a prospective randomized clinical trial comparing the clinical results of tenotomy and tenodesis. *Journal of shoulder and elbow surgery*; 2016.

1642. Leroux, Timothy, Chahal, Jaskarndip, Wasserstein, David, Verma, Nikhil N, Romeo, Anthony A. A systematic review and meta-analysis comparing clinical outcomes after concurrent rotator cuff repair and long head biceps tenodesis or tenotomy. *Sports health*; 2015.

1643. Lim, Sungjoon, Kim, Sang Ki, Kim, Yang-Soo. Comparison between SLAP Repair and Biceps Tenodesis with Concomitant Rotator Cuff Repair in Patients Older than 45 Years: Minimum 2-Year Clinical and Imaging Outcomes. *Clinics in Orthopedic Surgery*; 2020.

1644. Mardani-Kivi, M., Keyhani, S., Ebrahim-Zadeh, M. H., Hashemi-Motlagh, K., Saheb-Ekhtiari, K. Rotator cuff tear with concomitant long head of biceps tendon (LHBT) degeneration: what is the preferred choice? Open subpectoral versus arthroscopic intraarticular tenodesis. *J Orthop Traumatol*; Jul 5 2019.

1645. Mazzocca, Augustus D, Cote, Mark P, Arciero, Cristina L, Romeo, Anthony A, Arciero, Robert A. Clinical outcomes after subpectoral biceps tenodesis with an interference screw. *The American journal of sports medicine*; 2008.

1646. McCrum, Christopher L, Alluri, R Kiran, Batech, Michael, Mirzayan, Raffy. Complications of biceps tenodesis based on location, fixation, and indication: A review of 1526 shoulders. *Journal of shoulder and elbow surgery*; 2019.

1647. Meghpara, Mitchell B, Schulz, William, Buerba, Rafael A, Golan, Elan J, Vyas, Dharmesh. Clinical Outcomes of an All-Arthroscopic Biceps Tenodesis Using the Anterolateral Anchor During Concomitant Double-Row Rotator Cuff Repair. *Orthopaedic Journal of Sports Medicine*; 2020.

1648. Meraner, Dominik, Sternberg, Christoph, Vega, Jordi, Hahne, Julia, Kleine, Michael, Leuzinger, Jan. Arthroscopic tenodesis versus tenotomy of the long head of biceps tendon in simultaneous rotator cuff repair. *Archives of orthopaedic and trauma surgery*; 2016.

1649. Mijic, Dragomir, Kurowicki, Jennifer, Berglund, Derek, Rosas, Samuel, McNeely, Emmanuel, Motisi, Matthew, Polisetty, Teja, Levy, Jonathan C. Effect of biceps tenodesis on speed of recovery after arthroscopic rotator cuff repair. *JSES International*; 2020.

1650. Na, Yuyan, Zhu, Yong, Shi, Yuting, Ren, Yizhong, Zhang, Ting, Liu, Wanlin, Han, Changxu. A meta-analysis comparing tenotomy or tenodesis for lesions of the long head of the biceps tendon with concomitant reparable rotator cuff tears. *Journal of Orthopaedic Surgery and Research*; 2019.

1651. Nho, Shane J, Frank, Rachel M, Reiff, Stefanie N, Verma, Nikhil N, Romeo, Anthony A. Arthroscopic repair of anterosuperior rotator cuff tears combined with open biceps tenodesis. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2010.

1652. Oh, Joo Han, Lee, Ye Hyun, Kim, Sae Hoon, Park, Ji Soon, Seo, Hyuk Jun, Kim, Woo, Park, Hae Bong. Comparison of treatments for superior labrum–biceps complex lesions with concomitant rotator cuff repair: A prospective, randomized, comparative analysis of debridement, biceps tenotomy, and biceps tenodesis. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2016.

1653. Park, Ji Soon, Kim, Sae Hoon, Jung, Ho Jin, Lee, Ye Hyun, Oh, Joo Han. A prospective randomized study comparing the interference screw and suture anchor techniques for biceps tenodesis. *The American journal of sports medicine*; 2017.

1654. Provencher, Matthew T, McCormick, Frank, Peebles, Liam A, Beaulieu-Jones, Brendin R, Dekker, Travis J, LeClere, Lance E, Anthony, Shawn, Solomon, Daniel J, Golijanin, Petar, Dewing, Christopher. Outcomes of Primary Biceps Subpectoral Tenodesis in an Active Population: A Prospective Evaluation of 101 Patients. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2019.

1655. Shang, Xiliang, Chen, Jiwu, Chen, Shiyi. A meta-analysis comparing tenotomy and tenodesis for treating rotator cuff tears combined with long head of the biceps tendon lesions. *PLoS One*; 2017.

1656. Simmen, Beat R, Bachmann, Lucas M, Drerup, Susann, Schwyzer, Hans-Kaspar, Burkhart, Andreas, Flury, Matthias P, Goldhahn, Jörg. Usefulness of concomitant biceps tenodesis in total shoulder arthroplasty: a prospective cohort study. *Journal of shoulder and elbow surgery*; 2008.

1657. Uschok, S, Herrmann, S, Pauly, S, Perka, C, Greiner, S. Combined arthroscopic tenodesis of the long head of biceps and rotator cuff repair in antero-superior cuff tears. *Archives of orthopaedic and trauma surgery*; 2016.

1658. Soliman, Omar A, Koptan, Wael MT. Proximal humeral fractures treated with hemiarthroplasty: does tenodesis of the long head of the biceps improve results? *Injury*; 2013.

1659. Voss, Andreas, Cerciello, Simone, DiVenere, Jessica, Solovyova, Olga, Dyrna, Felix, Apostolakos, John, Lam, David, Cote, Mark P, Beitzel, Knut, Mazzocca, Augustus D. Open subpectoral biceps tenodesis in patients over 65 does not result in an increased rate of complications. *BMC musculoskeletal disorders*; 2017.

1660. Watson, Scott T, Robbins, Christopher B, Bedi, Asheesh, Carpenter, James E, Gagnier, Joel J, Miller, Bruce S. Comparison of outcomes 1 year after rotator cuff repair with and without concomitant biceps surgery. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*; 2017.

1661. Yi, Gang, Yang, Jing, Zhang, Lei, Liu, Yang, Guo, Xiaoguang, Fu, Shijie. Small-incision open distal subpectoral vs. arthroscopic proximal biceps tenodesis for biceps long head tendon lesions with repair of rotator cuff tears. *Experimental and Therapeutic Medicine*; 2020.

1662. Yi, Young, Lee, Jong-Myoung, Kwon, Seok Hyun, Kim, Jeong-Woo. Arthroscopic proximal versus open subpectoral biceps tenodesis with arthroscopic repair of small-or medium-sized rotator cuff tears. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2016.

1663. Zhang, Qiang, Zhou, Jiaojiao, Cheng, Biao. Tenotomy or tenodesis for long head biceps lesions in shoulders with reparable rotator cuff tears: a prospective randomised trial. *Knee Surgery, Sports Traumatology, Arthroscopy*; 2015.

1664. Anil, U., Hurley, E. T., Kingery, M. T., Pauzenberger, L., Mullett, H., Strauss, E. J. Surgical treatment for long head of the biceps tendinopathy: a network meta-analysis. *J Shoulder Elbow Surg*; Jun 2020.

1665. Creech, M. J., Yeung, M., Denkers, M., Simunovic, N., Athwal, G. S., Ayeni, O. R. Surgical indications for long head biceps tenodesis: a systematic review. *Knee Surg Sports Traumatol Arthrosc*; Jul 2016.

1666. Hsu, A. R., Ghodadra, N. S., Provencher, M. T., Lewis, P. B., Bach, B. R. Biceps tenotomy versus tenodesis: a review of clinical outcomes and biomechanical results. *J Shoulder Elbow Surg*; Mar 2011.

1667. van Deurzen, D. F. P., Gurnani, N., Alta, T. D. W., Willems, J. H., Onstenk, R., van den Bekerom, M. P. J. Suprapectoral versus subpectoral tenodesis for Long Head Biceps Brachii tendinopathy: A systematic review and meta-analysis. *Orthop Traumatol Surg Res*; Jun 2020.

1668. MacDonald, Peter, Verhulst, Fleur, McRae, Sheila, Old, Jason, Stranges, Greg, Dubberley, Jamie, Mascarenhas, Randy, Koenig, James, Leiter, Jeff, Nassar, Mark. Biceps tenodesis versus tenotomy in the treatment of lesions of the long head of the biceps tendon in patients undergoing arthroscopic shoulder surgery: a prospective double-blinded randomized controlled trial. *The American journal of sports medicine*; 2020.

1669. Beach, ZM,et al. Biceps tenotomy in the presence of a supraspinatus tear alters the adjacent intact tendons and glenoid cartilage. *Journal of Biomechanics*; 2017.

1670. De Carli, A et al. Reparable rotator cuff tears with concomitant long-head biceps lesions: tenotomy or tenotomy/tenodesis? *Knee Surg Sports Traumatol Arthrosc*; 2014.

1671. Friedman, JL,et al. Biceps tenotomy versus tenodesis in active patients younger than 55 years is there a difference in strength and outcomes? *Orthopaedic Journal of Sports Medicine*; 2015.

1672. Galasso, O.,et al. Tenotomy versus tenodesis in the treatment of the. *BMC Musculoskelet Disord*; 2012.

1673. Hassan, S, V, Patel. Biceps tenodesis versus biceps tenotomy for biceps tendinitis without rotator cuff tears. *Journal of Clinical Orthopaedics and Trauma*; 2019.

1674. Meeks, BD,et al.,. Patient satisfaction after biceps tenotomy. *Orthopaedic Journal of Sports Medicine*; 2017.

1675. Slenker, NR,et al. Biceps Tenotomy Versus Tenodesis: Clinical Outcomes. *Journal of Arthroscopic & Related Surgery*; 2012.

1676. van Deurzen, DF,et al. Long head BIceps TEnodesis or tenotomy in arthroscopic rotator cuff repair: BITE study protocol. *BMC Musculoskelet Disord*; 2016.

1677. Wittstein, JR,et al. Isokinetic strength, endurance, and subjective outcomes after biceps tenotomy versus tenodesis: A postoperative study. *American Journal of Sports Medicine*; 2011.

1678. Matsen, F. A.,3rd. Early effectiveness of shoulder arthroplasty for patients who have primary glenohumeral degenerative joint disease. *J Bone Joint Surg Am*; Feb 1996.

1679. Edwards, T Bradley, Boulahia, Aziz, Kempf, Jean-Francois, Boileau, Pascal, Nemoz, Chantal, Walch, Gilles. The influence of rotator cuff disease on the results of shoulder arthroplasty for primary osteoarthritis: results of a multicenter study. *Jbjs*; 2002.

1680. Fehringer, Edward V, Kopjar, Branko, Boorman, Richard S, Churchill, R Sean, Smith, Kevin L, Matsen III, Frederick A. Characterizing the functional improvement after total shoulder arthroplasty for osteoarthritis. *JBJS*; 2002.

1681. Godenèche, Arnaud, Boileau, Pascal, Favard, Luc, Le Huec, Jean-Charles, Lévigne, Christophe, Nové-Josserand, Laurent, Walch, Gilles, Edwards, T Bradley. Prosthetic replacement in the treatment of osteoarthritis of the shoulder: early results of 268 cases. *Journal of shoulder and elbow surgery*; 2002.

1682. Edwards, T. B., Kadakia, N. R., Boulahia, A., Kempf, J. F., Boileau, P., Nemoz, C., Walch, G. A comparison of hemiarthroplasty and total shoulder arthroplasty in the treatment of primary glenohumeral osteoarthritis: results of a multicenter study. *J Shoulder Elbow Surg*; May-Jun 2003.

1683. Iannotti, Joseph P, Norris, Tom R. Influence of preoperative factors on outcome of shoulder arthroplasty for glenohumeral osteoarthritis. *Jbjs*; 2003.

1684. Fama, Giuseppe, Edwards, T Bradley, Boulahia, Aziz, Kempf, Jean François, Boileau, Pascal, Némoz, Chantal, Walch, Gilles. The role of concomitant biceps tenodesis in shoulder arthroplasty for primary osteoarthritis: results of a multicentric study. *Orthopedics*; 2004.

1685. Sirveaux, F, Favard, L, Oudet, D, Huquet, D, Walch, G, Mole, D. Grammont inverted total shoulder arthroplasty in the treatment of glenohumeral osteoarthritis with massive rupture of the cuff: results of a multicentre study of 80 shoulders. *The Journal of bone and joint surgery. British volume*; 2004.

1686. Bryant, Dianne, Litchfield, Robert, Sandow, Michael, Gartsman, Gary M, Guyatt, Gordon, Kirkley, Alexandra. A comparison of pain, strength, range of motion, and functional outcomes after hemiarthroplasty and total shoulder arthroplasty in patients with osteoarthritis of the shoulder: a systematic review and meta-analysis. *JBJS*; 2005.

1687. Mileti, J, Sperling, JW, Cofield, RH, Harrington, JR, Hoskin, TL. Monoblock and modular total shoulder arthroplasty for osteoarthritis. *The Journal of bone and joint surgery. British volume*; 2005.

1688. Haines, JF, Trail, IA, Nuttall, D, Birch, A, Barrow, A. The results of arthroplasty in osteoarthritis of the shoulder. *The Journal of bone and joint surgery. British volume*; 2006.

1689. Raiss, P, Aldinger, PR, Kasten, P, Rickert, M, Loew, M. Total shoulder replacement in young and middle-aged patients with glenohumeral osteoarthritis. *The Journal of bone and joint surgery. British volume*; 2008.

1690. Bartelt, Robert, Sperling, John W, Schleck, Cathy D, Cofield, Robert H. Shoulder arthroplasty in patients aged fifty-five years or younger with osteoarthritis. *Journal of shoulder and elbow surgery*; 2011.

1691. Litchfield, Robert B, McKee, Micheal D, Balyk, Robert, Mandel, Scott, Holtby, Richard, Hollinshead, Robert, Drosdowech, Darren, Wambolt, S Elizabeth, Griffin, Sharon H, McCormack, Robert. Cemented versus uncemented fixation of humeral components in total shoulder arthroplasty for osteoarthritis of the shoulder: a prospective, randomized, double-blind clinical trial—a JOINTs Canada Project. *Journal of shoulder and elbow surgery*; 2011.

1692. Singh, Jasvinder A, Sperling, John, Buchbinder, Rachelle, McMAKEN, KELLY. Surgery for shoulder osteoarthritis: a Cochrane systematic review. *The Journal of rheumatology*; 2011.

1693. Young, A, Walch, G, Boileau, P, Favard, L, Gohlke, F, Loew, M, Molé, D. A multicentre study of the long-term results of using a flat-back polyethylene glenoid component in shoulder replacement for primary osteoarthritis. *The Journal of bone and joint surgery. British volume*; 2011.

1694. Young, Allan A, Walch, Gilles, Pape, Guido, Gohlke, Frank, Favard, Luc. Secondary rotator cuff dysfunction following total shoulder arthroplasty for primary glenohumeral osteoarthritis: results of a multicenter study with more than five years of follow-up. *JBJS*; 2012.

1695. Duan, Xin, Zhang, Wei, Dong, Xingxing, Liu, Ming, Gao, Yu, Huang, Fuguo, Li, Jian, Xiang, Zhou. Total shoulder arthroplasty versus hemiarthroplasty in patients with shoulder osteoarthritis: a meta-analysis of randomized controlled trials. *Seminars in arthritis and rheumatism*; 2013.

1696. Mizuno, Naoko, Denard, Patrick J, Raiss, Patric, Walch, Gilles. Reverse total shoulder arthroplasty for primary glenohumeral osteoarthritis in patients with a biconcave glenoid. *JBJS*; 2013.

1697. Sandow, Michael J, David, Huw, Bentall, Steven J. Hemiarthroplasty vs total shoulder replacement for rotator cuff intact osteoarthritis: how do they fare after a decade? *Journal of shoulder and elbow surgery*; 2013.

1698. van den Bekerom, Michel PJ, Geervliet, Pieter C, Somford, Matthijs P, van den Borne, Maaike PJ, Boer, Ronald. Total shoulder arthroplasty versus hemiarthroplasty for glenohumeral arthritis: a systematic review of the literature at long-term follow-up. *International journal of shoulder surgery*; 2013.

1699. Henry, Patrick, Razmjou, Helen, Dwyer, Tim, Shantz, Jesse A Slade, Holtby, Richard. Relationship between probability of future shoulder arthroplasty and outcomes of arthroscopic debridement in patients with advanced osteoarthritis of glenohumeral joint. *BMC musculoskeletal disorders*; 2015.

1700. Steen, Brandon M, Cabezas, Andres F, Santoni, Brandon G, Hussey, Michael M, Cusick, Michael C, Kumar, Avinash G, Frankle, Mark A. Outcome and value of reverse shoulder arthroplasty for treatment of glenohumeral osteoarthritis: a matched cohort. *Journal of shoulder and elbow surgery*; 2015.

1701. Levy, David M, Abrams, Geoffrey D, Harris, Joshua D, Bach Jr, Bernard R, Nicholson, Gregory P, Romeo, Anthony A. Rotator cuff tears after total shoulder arthroplasty in primary osteoarthritis: A systematic review. *International journal of shoulder surgery*; 2016.

1702. McFarland, Edward G, Huri, Gazi, Hyun, Yoon Suk, Petersen, Steve A, Srikumaran, Uma. Reverse total shoulder arthroplasty without bone-grafting for severe glenoid bone loss in patients with osteoarthritis and intact rotator cuff. *JBJS*; 2016.

1703. Kooistra, Bauke W, Willems, W Jaap, Lemmens, Eelke, Hartel, Bas P, van den Bekerom, Michel PJ, van Deurzen, Derek FP. Comparative study of total shoulder arthroplasty versus total shoulder surface replacement for glenohumeral osteoarthritis with minimum 2-year follow-up. *Journal of shoulder and elbow surgery*; 2017.

1704. Nicholson, Gregory P, Cvetanovich, Gregory L, Rao, Allison J, O'Donnell, Patrick. Posterior glenoid bone grafting in total shoulder arthroplasty for osteoarthritis with severe posterior glenoid wear. *Journal of shoulder and elbow surgery*; 2017.

1705. Ho, Jason C, Amini, Michael H, Entezari, Vahid, Jun, Bong Jae, Alolabi, Bashar, Ricchetti, Eric T, Iannotti, Joseph P. Clinical and radiographic outcomes of a posteriorly augmented glenoid component in anatomic total shoulder arthroplasty for primary osteoarthritis with posterior glenoid bone loss. *JBJS*; 2018.

1706. Mahony, Gregory T, Werner, Brian C, Chang, Brenda, Grawe, Brian M, Taylor, Samuel A, Craig, Edward V, Warren, Russell F, Dines, David M, Gulotta, Lawrence V. Risk factors for failing to achieve improvement after anatomic total shoulder arthroplasty for glenohumeral osteoarthritis. *Journal of shoulder and elbow surgery*; 2018.

1707. Merolla, Giovanni, Cerciello, Simone, Marenco, Stefano, Fabbri, Elisabetta, Paladini, Paolo, Porcellini, Giuseppe. Comparison of shoulder replacement to treat osteoarthritis secondary to instability surgery and primary osteoarthritis: a retrospective controlled study of patient outcomes. *International orthopaedics*; 2018.

1708. Pandya, Jay, Johnson, Tamara, Low, Adrian K. Shoulder replacement for osteoarthritis: a review of surgical management. *Maturitas*; 2018.

1709. Rasmussen, Jeppe Vejlgaard, Hole, R, Metlie, T, Brorson, Stig, Äärimaa, V, Demir, Yilmaz, Salomonsson, Björn, Jensen, SL. Anatomical total shoulder arthroplasty used for glenohumeral osteoarthritis has higher survival rates than hemiarthroplasty: a Nordic registry-based study. *Osteoarthritis and cartilage*; 2018.

1710. Bruttel, Hendrik, Spranz, David M, Bülhoff, Matthias, Aljohani, Nasser, Wolf, Sebastian I, Maier, Michael W. Comparison of glenohumeral and humerothoracical range of motion in healthy controls, osteoarthritic patients and patients after total shoulder arthroplasty performing different activities of daily living. *Gait & posture*; 2019.

1711. Collin, Philippe, Hervé, Anthony, Walch, Gilles, Boileau, Pascal, Muniandy, Moganadass, Chelli, Mickael. Mid-term results of reverse shoulder arthroplasty for glenohumeral osteoarthritis with posterior glenoid deficiency and humeral subluxation. *Journal of shoulder and elbow surgery*; 2019.

1712. Levine, William N, Munoz, Julianne, Hsu, Stephanie, Byram, Ian R, Bigliani, Louis U, Ahmad, Christopher S, Kongmalai, Pinkawas, Shillingford, Jamal N. Subscapularis tenotomy versus lesser tuberosity osteotomy during total shoulder arthroplasty for primary osteoarthritis: a prospective, randomized controlled trial. *Journal of shoulder and elbow surgery*; 2019.

1713. Neyton, Lionel, Kirsch, Jacob M, Collotte, Philippe, Collin, Philippe, Gossing, Louis, Chelli, Mikael, Walch, Gilles. Mid-to long-term follow-up of shoulder arthroplasty for primary glenohumeral osteoarthritis in patients aged 60 or under. *Journal of shoulder and elbow surgery*; 2019.

1714. Alikhah, Arad, Imiolczyk, Jan-Phillipp, Krukenberg, Anna, Scheibel, Markus. Screw fixation in stemless shoulder arthroplasty for the treatment of primary osteoarthritis leads to less osteolysis when compared to impaction fixation. *BMC musculoskeletal disorders*; 2020.

1715. Barret, Hugo, Gauci, Marc-Olivier, Langlais, Tristan, van der Meijden, Olivier, Tran, Laurie, Boileau, Pascal. Pyrocarbon interposition shoulder arthroplasty in young arthritic patients: a prospective observational study. *Journal of shoulder and elbow surgery*; 2020.

1716. Bender, Michael J, Morris, Brent J, Sheth, Mihir M, Laughlin, Mitzi S, Budeyri, Aydin, Le, Ryan K, Elkousy, Hussein A, Edwards, T Bradley. Outcomes of total shoulder arthroplasty for instability arthropathy with a prior coracoid transfer procedure: a retrospective review and matched cohort. *Journal of shoulder and elbow surgery*; 2020.

1717. Kwak, Jae-Man, Kim, Hyojune, Sun, Yucheng, Kholinne, Erica, Koh, Kyoung Hwan, Jeon, In-Ho. Arthroscopic osteocapsular arthroplasty for advanced-stage primary osteoarthritis of the elbow using a computed tomography–based classification. *Journal of shoulder and elbow surgery*; 2020.

1718. Ode, Gabriella E, Ling, Daphne, Finocchiaro, Anthony, Lai, Emily Ying, Taylor, Samuel A, Dines, Joshua, Dines, David, Warren, Russell, Gulotta, Lawrence. Clinical characteristics and patient-reported outcomes of total shoulder arthroplasty after anterior stabilization: a retrospective matched control study. *Journal of Shoulder and Elbow Surgery*; 2020.

1719. Romeo, Anthony A, Erickson, Brandon J, Costouros, John, Long, Nathan, Klassen, Jeffrey, Araghi, Arash, Brown, John, Setter, Kevin, Port, Joshua, Tyndall, William. Eclipse stemless shoulder prosthesis vs. Univers II shoulder prosthesis: a multicenter, prospective randomized controlled trial. *Journal of Shoulder and Elbow Surgery*; 2020.

1720. Wiater, J Michael, Levy, Jonathan C, Wright, Stephen A, Brockmeier, Stephen F, Duquin, Thomas R, Wright, Jonathan O, Codd, Timothy P. Prospective, Blinded, Randomized Controlled Trial of Stemless Versus Stemmed Humeral Components in Anatomic Total Shoulder Arthroplasty: Results at Short-Term Follow-up. *JBJS*; 2020.

1721. Orfaly, R. M., Rockwood, C. A.,Jr., Esenyel, C. Z., Wirth, M. A. A prospective functional outcome study of shoulder arthroplasty for osteoarthritis with an intact rotator cuff. *J Shoulder Elbow Surg*; May-Jun 2003.

1722. Smith, K. L., Matsen, F. A.,3rd. Total shoulder arthroplasty versus hemiarthroplasty. Current trends. *Orthop Clin North Am*; Jul 1998.

1723. Ballmer, Franz,T. Total shoulder arthroplasty: Some considerations related to glenoid surface contact. *Journal of Shoulder and Elbow Surgery*; 1994.

1724. Neer, C. S.,2nd. Replacement arthroplasty for glenohumeral osteoarthritis. *J Bone Joint Surg Am*; Jan 1974.

1725. Bell, S. N., Gschwend, N. Clinical experience with total arthroplasty and hemiarthroplasty of the shoulder using the Neer prosthesis. *Int Orthop*; 1986.

1726. Cofield, Robert H. MD ,Peter J. Daly,MD. Total shoulder arthroplasty with a tissue-ingrowth glenoid component*. *Journal of shoulder and elbow surgery*; 1992.

1727. Radnay, C. S., Setter, K. J., Chambers, L., Levine, W. N., Bigliani, L. U., Ahmad, C. S. Total shoulder replacement compared with humeral head replacement for the treatment of primary glenohumeral osteoarthritis: a systematic review. *J Shoulder Elbow Surg*; Jul-Aug 2007.

1728. Parsons, I. M. th, Weldon, E. J.,3rd, Titelman, R. M., Smith, K. L. Glenohumeral arthritis and its management. *Phys Med Rehabil Clin N Am*; May 2004.

1729. Weber, M., Berry, D. J., Harmsen, W. S. Total hip arthroplasty after operative treatment of an acetabular fracture. *J Bone Joint Surg Am*; Sep 1998.

1730. Brostrom, L. A., Kronberg, M., Wallensten, R. Should the glenoid be replaced in shoulder arthroplasty with an unconstrained Dana or St. Georg prosthesis? *Ann Chir Gynaecol*; 1992.

1731. Amstutz, H. C., Thomas, B. J., Kabo, J. M., Jinnah, R. H., Dorey, F. J. The Dana total shoulder arthroplasty. *J Bone Joint Surg Am*; Sep 1988.

1732. Torchia, M. E., Cofield, R. H., Settergren, C. R. Total shoulder arthroplasty with the Neer prosthesis: long-term results. *J Shoulder Elbow Surg*; Nov-Dec 1997.

1733. Cofield, R. H. Total shoulder arthroplasty with the Neer prosthesis. *J Bone Joint Surg Am*; Jul 1984.

1734. Barrett, W. P., Franklin, J. L., Jackins, S. E., Wyss, C. R., Matsen, F. A.,3rd. Total shoulder arthroplasty. *J Bone Joint Surg Am*; Jul 1987.

1735. Clayton, M. L., Ferlic, D. C., Jeffers, P. D. Prosthetic arthroplasties of the shoulder. *Clin Orthop Relat Res*; Apr 1982.

1736. Boyd, A. D.,Jr., Thomas, W. H., Scott, R. D., Sledge, C. B., Thornhill, T. S. Total shoulder arthroplasty versus hemiarthroplasty. Indications for glenoid resurfacing. *J Arthroplasty*; Dec 1990.

1737. Norris, B. L., Lachiewicz, P. F. Modern cement technique and the survivorship of total shoulder arthroplasty. *Clin Orthop Relat Res*; Jul 1996.

1738. Norris, T. R., Iannotti, J. P. Functional outcome after shoulder arthroplasty for primary osteoarthritis: a multicenter study. *J Shoulder Elbow Surg*; Mar-Apr 2002.

1739. Gartsman, G. M., Roddey, T. S., Hammerman, S. M. Shoulder arthroplasty with or without resurfacing of the glenoid in patients who have osteoarthritis. *J Bone Joint Surg Am*; Jan 2000.

1740. Blevins, F. T., Pollo, F. E., Torzilli, P. A., Warren, R. F. Effect of humeral head component size on hemiarthroplasty translations and rotations. *J Shoulder Elbow Surg*; Nov-Dec 1998.

1741. Fuerst, M., Fink, B., Ruther, W. The DUROM cup humeral surface replacement in patients with rheumatoid arthritis. *J Bone Joint Surg Am*; Aug 2007.

1742. Burgess DL, McGrath MS,Bonutti PM,Marker DR,Delanois RE,Mont MA. Shoulder Resurfacing. 2009.

1743. Ellenbecker, T. S., Bailie, D. S., Lamprecht, D. Humeral resurfacing hemiarthroplasty with meniscal allograft in a young patient with glenohumeral osteoarthritis. *J Orthop Sports Phys Ther*; May 2008.

1744. Burkhead WZ, Jr.,Hutton KS. Biologic resurfacing of the glenoid with hemiarthroplasty of the shoulder. *J Shoulder Elbow Surg*; 1995.

1745. Burkhead WZ, Jr.,Krishnan SG,Lin KC. Biologic resurfacing of the arthritic glenohumeral joint: Historical review and current applications. *J Shoulder Elbow Surg*; 2007.

1746. Raiss, P., Aldinger, P. R., Kasten, P., Rickert, M., Loew, M. Humeral head resurfacing for fixed anterior glenohumeral dislocation. *Int Orthop*; Apr 2009.

1747. Harryman DT, Sidles JA Harris SL Lippitt SB Matsen FA 3rd. he effect of articular conformity and the size of the humeral head component on laxity and motion after glenohumeral arthroplasty. A study in cadavera. *J Bone Joint Surg Am*; 1995.

1748. Thomas, S. R., Sforza, G., Levy, O., Copeland, S. A. Geometrical analysis of Copeland surface replacement shoulder arthroplasty in relation to normal anatomy. *J Shoulder Elbow Surg*; Mar-Apr 2005.

1749. Thomas, S. R., Wilson, A. J., Chambler, A., Harding, I., Thomas, M. Outcome of Copeland surface replacement shoulder arthroplasty. *J Shoulder Elbow Surg*; Sep-Oct 2005.

1750. Levy, O., Copeland, S. A. Cementless surface replacement arthroplasty of the shoulder. 5- to 10-year results with the Copeland mark-2 prosthesis. *J Bone Joint Surg Br*; Mar 2001.

1751. Levy, O., Copeland, S. A. Cementless surface replacement arthroplasty (Copeland CSRA) for osteoarthritis of the shoulder. *J Shoulder Elbow Surg*; May-Jun 2004.

1752. Levy, O., Funk, L., Sforza, G., Copeland, S. A. Copeland surface replacement arthroplasty of the shoulder in rheumatoid arthritis. *J Bone Joint Surg Am*; Mar 2004.

1753. Copeland, S. The continuing development of shoulder replacement: "reaching the surface". *J Bone Joint Surg Am*; Apr 2006.

1754. Savoie, F. H.,3rd, Brislin, K. J., Argo, D. Arthroscopic glenoid resurfacing as a surgical treatment for glenohumeral arthritis in the young patient: midterm results. *Arthroscopy*; Aug 2009.

1755. Alund, M., Hoe-Hansen, C., Tillander, B., Heden, B. A., Norlin, R. Outcome after cup hemiarthroplasty in the rheumatoid shoulder: a retrospective evaluation of 39 patients followed for 2-6 years. *Acta Orthop Scand*; Apr 2000.

1756. Fink, B., Singer, J., Lamla, U., Ruther, W. Surface replacement of the humeral head in rheumatoid arthritis. *Arch Orthop Trauma Surg*; Jul 2004.

1757. Buchner, M., Eschbach, N., Loew, M. Comparison of the short-term functional results after surface replacement and total shoulder arthroplasty for osteoarthritis of the shoulder: a matched-pair analysis. *Arch Orthop Trauma Surg*; Apr 2008.

1758. Scalise, JJ, Miniaci, A, Iannotti, JP. Resurfacing arthroplasty of the humerus: indications, surgical technique, and clinical results. *Tech Shoulder Elbow Surg*; 2007.

1759. Misamore, GW. Management of osteoarthritis of the shoulder. *Orthopaedic Knowledge Update: Shoulder and Elbow*; 1997.

1760. Woodhouse, C. F. Dynamic influences of vascular occlusion affecting the development of avascular necrosis of the femoral head. *Clin Orthop Relat Res*; Jan-Feb 1964.

1761. Rosingh, G. E., Steendijk, R., van den Hooff, A. Consequences of avascular necrosis of the femoral head in rabbits. A histological and radiological study. *J Bone Joint Surg Br*; Aug 1969.

1762. Sarris, I., Weiser, R., Sotereanos, D. G. Pathogenesis and treatment of osteonecrosis of the shoulder. *Orthop Clin North Am*; Jul 2004.

1763. Jones, J. P.,Jr. Concepts of etiology and early pathogenesis of osteonecrosis. *Instr Course Lect*; 1994.

1764. Hattrup, SJ,Cofield,RH. Osteonecrosis of the humeral head: relationship of disease stage, extent, and cause to natural history. *J Shoulder Elbow Surg*; 1999.

1765. Volokh, K. Y., Yoshida, H., Leali, A., Fetto, J. F., Chao, E. Y. Prediction of femoral head collapse in osteonecrosis. *J Biomech Eng*; Jun 2006.

1766. Cruess, R. L. Steroid-induced avascular necrosis of the head of the humerus. Natural history and management. *J Bone Joint Surg Br*; Aug 1976.

1767. Usher, B. W.,Jr., Friedman, R. J. Steroid-induced osteonecrosis of the humeral head. *Orthopedics*; Jan 1995.

1768. Loebenberg, M. I., Plate, A. M., Zuckerman, J. D. Osteonecrosis of the humeral head. *Instr Course Lect*; 1999.

1769. Nixon, JE. Avascular necrosis of bone: a review. *J R Soc Med*; 1983.

1770. Pritchett, J. W. Statin therapy decreases the risk of osteonecrosis in patients receiving steroids. *Clin Orthop Relat Res*; May 2001.

1771. Mankin, H. J. Nontraumatic necrosis of bone (osteonecrosis). *N Engl J Med*; May 28 1992.

1772. Mont, MA, Hungerford, DS. Non-traumatic avascular necrosis of the femoral head. *J Bone Joint Surg Am*; 1995.

1773. Cruess, R. L. Corticosteroid-induced osteonecrosis of the humeral head. *Orthop Clin North Am*; Oct 1985.

1774. Valencia, M. E., Barreiro, P., Soriano, V., Blanco, F., Moreno, V., Lahoz, J. G. Avascular necrosis in HIV-infected patients receiving antiretroviral treatment: study of seven cases. *HIV Clin Trials*; Mar-Apr 2003.

1775. Jones, L. C., Mont, M. A., Le, T. B., Petri, M., Hungerford, D. S., Wang, P., Glueck, C. J. Procoagulants and osteonecrosis. *J Rheumatol*; Apr 2003.

1776. Chang, C. C., Greenspan, A., Gershwin, M. E. Osteonecrosis: current perspectives on pathogenesis and treatment. *Semin Arthritis Rheum*; Aug 1993.

1777. Glesby, M. J. Bone disorders in human immunodeficiency virus infection. *Clin Infect Dis*; 2003.

1778. Koo, K. H., Kim, R., Ko, G. H., Song, H. R., Jeong, S. T., Cho, S. H. Preventing collapse in early osteonecrosis of the femoral head. A randomised clinical trial of core decompression. *J Bone Joint Surg Br*; Nov 1995.

1779. Wang, C. J., Wang, F. S., Huang, C. C., Yang, K. D., Weng, L. H., Huang, H. Y. Treatment for osteonecrosis of the femoral head: comparison of extracorporeal shock waves with core decompression and bone-grafting. *J Bone Joint Surg Am*; Nov 2005.

1780. Babis GC, Soucacos PN. Effectiveness of total hip arthroplasty in the management of hip osteonecrosis. *Ortho Clinics of No Am*; 2004.

1781. Hungerford, DS. Bone marrow pressure, venography and core decompression in ischemic necrosis of the femoral head. *The Hip: Proceedings of the Seventh Open Scientific Meeting of the Hip Society*; 1979.

1782. LaPorte, D. M., Mont, M. A., Mohan, V., Pierre-Jacques, H., Jones, L. C., Hungerford, D. S. Osteonecrosis of the humeral head treated by core decompression. *Clin Orthop Relat Res*; Oct 1998.

1783. Kim, S. H., Kim, H. K., Sun, J. I., Park, J. S., Oh, I. Arthroscopic capsulolabroplasty for posteroinferior multidirectional instability of the shoulder. *Am J Sports Med*; Apr-May 2004.

1784. Marker, D. R., Seyler, T. M., Ulrich, S. D., Srivastava, S., Mont, M. A. Do modern techniques improve core decompression outcomes for hip osteonecrosis? *Clin Orthop Relat Res*; May 2008.

1785. Mont, M. A., Ragland, P. S., Etienne, G. Core decompression of the femoral head for osteonecrosis using percutaneous multiple small-diameter drilling. *Clin Orthop Relat Res*; Dec 2004.

1786. Mont, M. A., Maar, D. C., Urquhart, M. W., Lennox, D., Hungerford, D. S. Avascular necrosis of the humeral head treated by core decompression. A retrospective review. *J Bone Joint Surg Br*; Sep 1993.

1787. Hardy, P., Decrette, E., Jeanrot, C., Colom, A., Lortat-Jacob, A., Benoit, J. Arthroscopic treatment of bilateral humeral head osteonecrosis. *Arthroscopy*; Apr 2000.

1788. Shannon, B. D., Trousdale, R. T. Femoral osteotomies for avascular necrosis of the femoral head. *Clin Orthop Relat Res*; Jan 2004.

1789. Castro, F. P.,Jr., Barrack, R. L. Core decompression and conservative treatment for avascular necrosis of the femoral head: a meta-analysis. *Am J Orthop*; Mar 2000.

1790. Learmonth, I. D., Maloon, S., Dall, G. Core decompression for early atraumatic osteonecrosis of the femoral head. *J Bone Joint Surg Br*; May 1990.

1791. Scully, S. P., Aaron, R. K., Urbaniak, J. R. Survival analysis of hips treated with core decompression or vascularized fibular grafting because of avascular necrosis. *J Bone Joint Surg Am*; Sep 1998.

1792. Chapman, C., Mattern, C., Levine, W. N. Arthroscopically assisted core decompression of the proximal humerus for avascular necrosis. *Arthroscopy*; Nov 2004.

1793. Dines, J. S., Strauss, E. J., Fealy, S., Craig, E. V. Arthroscopic-assisted core decompression of the humeral head. *Arthroscopy*; Jan 2007.

1794. Aldridge, J. M.,3rd, Urbaniak, J. R. Avascular necrosis of the femoral head: role of vascularized bone grafts. *Orthop Clin North Am*; Jan 2007.

1795. Rindell, K. Muscle pedicled bone graft in revascularization of aseptic necrosis of the humeral head. *Ann Chir Gynaecol*; 1987.

1796. Yajima, H., Tamai, S., Ono, H., Kizaki, K. Vascularized bone grafts to the upper extremities. *Plast Reconstr Surg*; Mar 1998.

1797. Seyler, T. M., Marker, D. R., Ulrich, S. D., Fatscher, T., Mont, M. A. Nonvascularized bone grafting defers joint arthroplasty in hip osteonecrosis. *Clin Orthop Relat Res*; May 2008.

1798. Parsch, D., Lehner, B., Loew, M. Shoulder arthroplasty in nontraumatic osteonecrosis of the humeral head. *J Shoulder Elbow Surg*; May-Jun 2003.

1799. Mansat, P., Huser, L., Mansat, M., Bellumore, Y., Rongieres, M., Bonnevialle, P. Shoulder arthroplasty for atraumatic avascular necrosis of the humeral head: nineteen shoulders followed up for a mean of seven years. *J Shoulder Elbow Surg*; Mar-Apr 2005.

1800. Orfaly, R. M., Rockwood, C. A.,Jr., Esenyel, C. Z., Wirth, M. A. Shoulder arthroplasty in cases with avascular necrosis of the humeral head. *J Shoulder Elbow Surg*; May-Jun 2007.

1801. Cruess, R. L. Experience with steroid-induced avascular necrosis of the shoulder and etiologic considerations regarding osteonecrosis of the hip. *Clin Orthop Relat Res*; Jan-Feb 1978.

1802. Lau, M. W., Blinder, M. A., Williams, K., Galatz, L. M. Shoulder arthroplasty in sickle cell patients with humeral head avascular necrosis. *J Shoulder Elbow Surg*; Mar-Apr 2007.

1803. Barnes, C. L., Collins, D. N., Nelson, C. L. Cup arthroplasty, surface replacement arthroplasty, and femoral head resurfacing for osteonecrosis. *Semin Arthroplasty*; Jul 1991.

1804. Adili, A., Trousdale, R. T. Femoral head resurfacing for the treatment of osteonecrosis in the young patient. *Clin Orthop Relat Res*; Dec 2003.

1805. Aaron, RK,Steinberg,ME. Electrical stimulation of osteonecrosis of the femoral head. *Semin Arthroplasty*; 1991.

1806. Marchant Jr, Milford H, Stubbs, Allston J, Basamania, Carl J. Technique and early results of intramedullary pressure-guided core decompression of the humeral head for nontraumatic osteonecrosis. *Techniques in Shoulder & Elbow Surgery*; 2008.

1807. Guerin, Gilles, Habibi, Anoosha, Hernigou, Philippe, Zilber, Sebastien. Core decompression with autologous bone marrow aspirate injection in humeral head osteonecrosis in adults with sickle cell disease. *International Orthopaedics*; 2021.

1808. Hernigou, Philippe, Hernigou, Jacques, Scarlat, Marius. Mesenchymal stem cell therapy improved outcome of early post-traumatic shoulder osteonecrosis: a prospective randomized clinical study of fifty patients with over ten year follow-up. *International Orthopaedics*; 2021.

1809. Steinberg, M. E., Larcom, P. G., Strafford, B., Hosick, W. B., Corces, A., Bands, R. E., Hartman, K. E. Core decompression with bone grafting for osteonecrosis of the femoral head. *Clin Orthop Relat Res*; May 2001.

1810. Warner, J. J., Philip, J. H., Brodsky, G. L., Thornhill, T. S. Studies of nontraumatic osteonecrosis. The role of core decompression in the treatment of nontraumatic osteonecrosis of the femoral head. *Clin Orthop Relat Res*; Dec 1987.

1811. Rijnen, W. H., Gardeniers, J. W., Buma, P., Yamano, K., Slooff, T. J., Schreurs, B. W. Treatment of femoral head osteonecrosis using bone impaction grafting. *Clin Orthop Relat Res*; Dec 2003.

1812. Stulberg, B. N., Davis, A. W., Bauer, T. W., Levine, M., Easley, K. Osteonecrosis of the femoral head. A prospective randomized treatment protocol. *Clin Orthop Relat Res*; Jul 1991.

1813. Allen, Donald A., Merrill, Christian, Cote, Mark P., Mazzocca, Augustus D. Inlay hemiarthroplasty of the humeral head for nontraumatic osteonecrosis. *Seminars in arthroplasty.*; 2020.

1814. Feeley, B., Fealy, S., Dines, D., Warren, R., Craig, E. Hemiarthroplasty and total shoulder arthroplasty for avascular necrosis of the humeral head. *JSES*; 2008.

1815. Franceschi, Francesco, Franceschetti, Edoardo, Paciotti, Michele, Torre, Guglielmo, Samuelsson, Kristian, Papalia, Rocco, Karlsson, Jón, Denaro, Vincenzo. Surgical management of osteonecrosis of the humeral head: a systematic review. *Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA.*; 2017.

1816. Gadea, F., Alami, G., Pape, G., Boileau, P., Favard, L. Shoulder hemiarthroplasty: outcomes and long-term survival analysis according to etiology. *Orthopaedics & traumatology, surgery & research.*; 2012.

1817. Le Coz, P., Herve, A., Thomazeau, H. Surgical treatments of atraumatic avascular necrosis of the shoulder. *Morphologie : bulletin de l'Association des anatomistes.*; 2021.

1818. Raiss, Patric, Kasten, Philip, Baumann, Florian, Moser, Michael, Rickert, Markus, Loew, Markus. Treatment of osteonecrosis of the humeral head with cementless surface replacement arthroplasty. *Journal of bone and joint surgery.*; 2009.

1819. Ristow, Jacob J., Ellison, Ciani M., Mickschl, Dara J., Berg, Kenneth C., Haidet, Kirk C., Gray, Jason R., Grindel, Steven I. Outcomes of shoulder replacement in humeral head avascular necrosis. *Journal of shoulder and elbow surgery : JSES.*; 2019.

1820. Schoch, Bradley S., Barlow, Jonathan D., Schleck, Cathy, Cofield, Robert H., Sperling, John W. Shoulder arthroplasty for atraumatic osteonecrosis of the humeral head. *Journal of shoulder and elbow surgery : JSES.*; 2016.

1821. Sowa, Boris, Thierjung, Heidi, Bülhoff, Matthias, Loew, Markus, Zeifang, Felix, Bruckner, Thomas, Raiss, Patric. Functional results of hemi- and total shoulder arthroplasty according to diagnosis and patient age at surgery. *Acta orthopaedica.*; 2017.

1822. Sweet, Stephan J., Takara, Tad, Ho, Lance, Tibone, James E. Primary partial humeral head resurfacing: outcomes with the HemiCAP implant. *The American journal of sports medicine.*; 2015.

1823. Uribe, J., Botto-van Bemden, A. Partial humeral head resurfacing for osteonecrosis. *JSES*; 2009.

1824. Dacre, J. E., Beeney, N., Scott, D. L. Injections and physiotherapy for the painful stiff shoulder. *Ann Rheum Dis*; Apr 1989.

1825. Duplay, . Rotator cuff disease. *Arch Gén Méd*; 1872.

1826. Neviaser, JS. Adhesive capsulitis of the shoulder. A study of the pathological findings in periarthritis of the shoulder. *J. Bone and Joint Surg*; 1945.

1827. Itoi, E. Pathophysiology and treatment of atraumatic instability of the shoulder. *J Orthop Sci*; 2004.

1828. Lundberg, J. The frozen shoulder. Clinical and radiographical observations. The effect of manipulation under general anesthesia. Structure and glycosaminoglycan content of the joint capsule. Local bone metabolism. *Acta Orthop Scand*; 1969.

1829. Wiley, A. M. Arthroscopic appearance of frozen shoulder. *Arthroscopy*; 1991.

1830. Bunker, TD,Anthony,PP. The pathology of frozen shoulder. A Dupuytren-like disease. *J Bone Joint Surg Br*; 1995.

1831. Binder, A. I., Bulgen, D. Y., Hazleman, B. L., Roberts, S. Frozen shoulder: a long-term prospective study. *Ann Rheum Dis*; Jun 1984.

1832. Griggs, S. M., Ahn, A., Green, A. Idiopathic adhesive capsulitis. A prospective functional outcome study of nonoperative treatment. *J Bone Joint Surg Am*; Oct 2000.

1833. Grubbs, N. Frozen shoulder syndrome: a review of literature. *J Orthop Sports Phys Ther*; Sep 1993.

1834. Andersen, N. H., Johannsen, H. V., Sneppen, O., Sojbjerg, J. O. Frozen shoulder. Arthroscopy and manipulation in general anesthesia, followed by early passive mobilization. *Ugeskr Laeger*; Jan 8 1996.

1835. Quraishi, N. A., Johnston, P., Bayer, J., Crowe, M., Chakrabarti, A. J. Thawing the frozen shoulder. A randomised trial comparing manipulation under anaesthesia with hydrodilatation. *J Bone Joint Surg Br*; Sep 2007.

1836. Grey, R. G. The natural history of "idiopathic" frozen shoulder. *J Bone Joint Surg Am*; Jun 1978.

1837. Reeves, B. The natural history of the frozen shoulder syndrome. *Scand J Rheumatol*; 1975.

1838. Hannafin, J. A., Chiaia, T. A. Adhesive capsulitis. A treatment approach. *Clin Orthop Relat Res*; Mar 2000.

1839. Miller, M. D., Wirth, M. A., Rockwood, C. A.,Jr. Thawing the frozen shoulder: the "patient" patient. *Orthopedics*; Oct 1996.

1840. Rowe, C. R. Recurrent anterior transient subluxation of the shoulder. The "dead arm" syndrome. *Orthop Clin North Am*; Oct 1988.

1841. Siegel, L. B., Cohen, N. J., Gall, E. P. Adhesive capsulitis: a sticky issue. *Am Fam Physician*; Apr 1 1999.

1842. Diercks, R. L., Stevens, M. Gentle thawing of the frozen shoulder: a prospective study of supervised neglect versus intensive physical therapy in seventy-seven patients with frozen shoulder syndrome followed up for two years. *J Shoulder Elbow Surg*; Sep-Oct 2004.

1843. Shaffer, B., Tibone, J. E., Kerlan, R. K. Frozen shoulder. A long-term follow-up. *J Bone Joint Surg Am*; Jun 1992.

1844. Murnaghan, JP. Frozen shoulder. *The Shoulder*; 1990.

1845. Vecchio, P., Kavanagh, R., Hazleman, B. L., King, R. H. Shoulder pain in a community-based rheumatology clinic. *Br J Rheumatol*; May 1995.

1846. Simmonds, F. A. Shoulder pain with particular reference to the frozen shoulder. *J Bone Joint Surg Br*; Aug 1949.

1847. Murnaghan, J. P. Adhesive capsulitis of the shoulder: current concepts and treatment. *Orthopedics*; Jan 1988.

1848. Hazleman, BL. The painful stiff shoulder. *Rheumatol Phys Med*; 1972.

1849. Fleming, A., Dodman, S., Beer, T. C., Crown, S. Personality in frozen shoulder. *Ann Rheum Dis*; Oct 1975.

1850. Andersen, N. H., Sojbjerg, J. O., Johannsen, H. V., Sneppen, O. Frozen shoulder: arthroscopy and manipulation under general anesthesia and early passive motion. *J Shoulder Elbow Surg*; May-Jun 1998.

1851. Mulcahy, K. A., Baxter, A. D., Oni, O. O., Finlay, D. The value of shoulder distension arthrography with intraarticular injection of steroid and local anaesthetic: a follow-up study. *Br J Radiol*; Mar 1994.

1852. Bulgen, D. Y., Binder, A. I., Hazleman, B. L., Dutton, J., Roberts, S. Frozen shoulder: prospective clinical study with an evaluation of three treatment regimens. *Ann Rheum Dis*; Jun 1984.

1853. Massoud, S. N., Pearse, E. O., Levy, O., Copeland, S. A. Operative management of the frozen shoulder in patients with diabetes. *J Shoulder Elbow Surg*; Nov-Dec 2002.

1854. Hamdan, T. A., Al-Essa, K. A. Manipulation under anaesthesia for the treatment of frozen shoulder. *Int Orthop*; 2003.

1855. Kivimaki, J., Pohjolainen, T., Malmivaara, A., Kannisto, M., Guillaume, J., Seitsalo, S., Nissinen, M. Manipulation under anesthesia with home exercises versus home exercises alone in the treatment of frozen shoulder: a randomized, controlled trial with 125 patients. *J Shoulder Elbow Surg*; Nov-Dec 2007.

1856. Bridgman, J. F. Periarthritis of the shoulder and diabetes mellitus. *Ann Rheum Dis*; Jan 1972.

1857. Pal, B., Anderson, J., Dick, W. C., Griffiths, I. D. Limitation of joint mobility and shoulder capsulitis in insulin- and non-insulin-dependent diabetes mellitus. *Br J Rheumatol*; May 1986.

1858. Ogilvie-Harris, D. J., Myerthall, S. The diabetic frozen shoulder: arthroscopic release. *Arthroscopy*; Feb 1997.

1859. Wohlgethan, J. R. Frozen shoulder in hyperthyroidism. *Arthritis Rheum*; Aug 1987.

1860. Fisher, L., Kurtz, A., Shipley, M. Association between cheiroarthropathy and frozen shoulder in patients with insulin-dependent diabetes mellitus. *Br J Rheumatol*; May 1986.

1861. Coventry, M. B. Problem of painful shoulder. *J Am Med Assoc*; Jan 17 1953.

1862. Chan, Justin H, Ho, Bryant S, Alvi, Hasham M, Saltzman, Matthew D, Marra, Guido. The relationship between the incidence of adhesive capsulitis and hemoglobin A1c. *Journal of shoulder and elbow surgery*; 2017.

1863. Bulgen, D. Y., Hazleman, B. L., Voak, D. HLA-B27 and frozen shoulder. *Lancet*; May 15 1976.

1864. Ross, D. G. Diagnostic overview: frozen shoulder. *Orthop Nurs*; Mar-Apr 1983.

1865. Hakuno, A., Sashika, H., Ohkawa, T., Itoh, R. Arthrographic findings in hemiplegic shoulders. *Arch Phys Med Rehabil*; Nov 1984.

1866. Bowman, C. A., Jeffcoate, W. J., Pattrick, M., Doherty, M. Bilateral adhesive capsulitis, oligoarthritis and proximal myopathy as presentation of hypothyroidism. *Br J Rheumatol*; Feb 1988.

1867. Bulgen, D., Hazleman, B., Ward, M., McCallum, M. Immunological studies in frozen shoulder. *Ann Rheum Dis*; Apr 1978.

1868. Esch, JC. Arthroscopic treatment of resistant primary (idiopathic) frozen shoulder. *J Shoulder Elbow Surg*; 1994.

1869. Janda, DH, Hawkins, RJ. Shoulder manipulation in patients with adhesive capsulitis and diabetes mellitus: a clinical note. *J Shoulder Elbow Surg*; 1993.

1870. Pollock, R. G., Duralde, X. A., Flatow, E. L., Bigliani, L. U. The use of arthroscopy in the treatment of resistant frozen shoulder. *Clin Orthop Relat Res*; Jul 1994.

1871. Lorenz, T. H., Musser, M. J. Life stress, emotions and painful stiff shoulder. *Ann Intern Med*; Dec 1952.

1872. Oesterreicher, W., Van, D. A. M. Social psychological researches into brachialgia and periarthritis. *Arthritis Rheum*; Dec 1964.

1873. Baslund, B., Thomsen, B. S., Jensen, E. M. Frozen shoulder: current concepts. *Scand J Rheumatol*; 1990.

1874. van der Heijden, G. J. Shoulder disorders: a state-of-the-art review. *Baillieres Best Pract Res Clin Rheumatol*; Jun 1999.

1875. Redler, Lauren H, Dennis, Elizabeth R. Treatment of adhesive capsulitis of the shoulder. *JAAOS-Journal of the American Academy of Orthopaedic Surgeons*; 2019.

1876. Peet, R. M., Henriksen, J. D., Anderson, T. P., Martin, G. M. Thoracic-outlet syndrome: evaluation of a therapeutic exercise program. *Proc Staff Meet Mayo Clin*; May 2 1956.

1877. Huang, J. H., Zager, E. L. Thoracic outlet syndrome. *Neurosurgery*; Oct 2004.

1878. Wilbourn, A. J. Thoracic outlet syndrome is overdiagnosed. *Muscle Nerve*; Jan 1999.

1879. Roos, D. B. The thoracic outlet syndrome is underrated. *Arch Neurol*; Mar 1990.

1880. Fechter, J. D., Kuschner, S. H. The thoracic outlet syndrome. *Orthopedics*; Nov 1993.

1881. Povlsen, S., Povlsen, B. Diagnosing Thoracic Outlet Syndrome: Current Approaches and Future Directions. *Diagnostics (Basel)*; Mar 20 2018.

1882. George, E. L., Arya, S., Rothenberg, K. A., Hernandez-Boussard, T., Ho, V. T., Stern, J. R., Gelabert, H. A., Lee, J. T. Contemporary Practices and Complications of Surgery for Thoracic Outlet Syndrome in the United States. *Ann Vasc Surg*; Apr 2021.

1883. Campbell, J. N., Naff, N. J., Dellon, A. L. Thoracic outlet syndrome. Neurosurgical perspective. *Neurosurg Clin N Am*; Jan 1991.

1884. Singh, V. K., Singh, P. K., Balakrishnan, S. K. Bilateral coracoclavicular joints as a rare cause of bilateral thoracic outlet syndrome and shoulder pain treated successfully by conservative means. *Singapore Med J*; Jun 2009.

1885. Iwuagwu, O. C., Bajalan, A. A., Platt, A. J., Stanley, P. R., Drew, P. J. Effects of reduction mammoplasty on upper-limb nerve conduction across the thoracic outlet in women with macromastia: a prospective randomized study. *Ann Plast Surg*; Nov 2005.

1886. Alexandre, A., Coro, L., Azuelos, A., Pellone, M. Thoracic outlet syndrome due to hyperextension-hyperflexion cervical injury. *Acta Neurochir Suppl*; 2005.

1887. Crotti, F. M., Carai, A., Carai, M., Grimoldi, N., Sgaramella, E., Sias, W., Tiberio, F. TOS pathophysiology and clinical features. *Acta Neurochir Suppl*; 2005.

1888. Yoo, M. J., Seo, J. B., Kim, J. P., Lee, J. H. Surgical treatment of thoracic outlet syndrome secondary to clavicular malunion. *Clin Orthop Surg*; Mar 2009.

1889. Pang, D., Wessel, H. B. Thoracic outlet syndrome. *Neurosurgery*; Jan 1988.

1890. Hussain, M. A., Aljabri, B., Al-Omran, M. Vascular Thoracic Outlet Syndrome. *Semin Thorac Cardiovasc Surg*; Spring 2016.

1891. Juvonen, T., Satta, J., Laitala, P., Luukkonen, K., Nissinen, J. Anomalies at the thoracic outlet are frequent in the general population. *Am J Surg*; Jul 1995.

1892. Roos, D. B. Edgar J. Poth Lecture. Thoracic outlet syndromes: update 1987. *Am J Surg*; Dec 1987.

1893. Roos, D. B. Experience with first rib resection for thoracic outlet syndrome. *Ann Surg*; Mar 1971.

1894. Rob, C. G., Standeven, A. Arterial occlusion complicating thoracic outlet compression syndrome. *Br Med J*; Sep 20 1958.

1895. Huges, ES. Venous obstruction in upper extremity. *Brit J Surg*; 1948.

1896. Moore, R., Wei Lum, Y. Venous thoracic outlet syndrome. *Vasc Med*; Apr 2015.

1897. Schubart, PJ, Haeberlin, JR, Porter, JM. Intermittent subclavian venous obstruction: utility of venous pressure gradients. *Surgery*; 1986.

1898. Perler, B. A., Mitchell, S. E. Percutaneous transluminal angioplasty and transaxillary first rib resection. A multidisciplinary approach to the thoracic outlet syndrome. *Am Surg*; Sep 1986.

1899. Wilbourn, A. J. Thoracic outlet syndrome surgery causing severe brachial plexopathy. *Muscle Nerve*; Jan 1988.

1900. Atasoy, E. A hand surgeon's advanced experience with thoracic outlet compression syndrome. *Handchir Mikrochir Plast Chir*; Jun 2013.

1901. Kaymak, B., Ozcakar, L., Oguz, A. K., Arsava, M., Ozdol, C. A novel finding in thoracic outlet syndrome: tachycardia. *Joint Bone Spine*; Sep 2004.

1902. Ozcakar, L., Inanici, F., Kaymak, B., Abali, G., Cetin, A., Hascelik, Z. Quantification of the weakness and fatigue in thoracic outlet syndrome with isokinetic measurements. *Br J Sports Med*; Mar 2005.

1903. DiLosa, K. L., Humphries, M. D. Epidemiology of thoracic outlet syndrome. *Semin Vasc Surg*; Mar 2021.

1904. Parziale, J. R., Akelman, E., Weiss, A. P., Green, A. Thoracic outlet syndrome. *Am J Orthop (Belle Mead NJ)*; May 2000.

1905. Povlsen, B., Belzberg, A., Hansson, T., Dorsi, M. Treatment for thoracic outlet syndrome. *Cochrane Database Syst Rev*; 2010.

1906. Muscolino, J. E. Upper extremity paraesthesia: clinical assessment and reasoning. *J Bodyw Mov Ther*; Jul 2008.

1907. Lindgren, K. A. Conservative treatment of thoracic outlet syndrome: a 2-year follow-up. *Arch Phys Med Rehabil*; Apr 1997.

1908. Crosby, C. A., Wehbe, M. A. Conservative treatment for thoracic outlet syndrome. *Hand Clin*; Feb 2004.

1909. Hanif, S., Tassadaq, N., Rathore, M. F., Rashid, P., Ahmed, N., Niazi, F. Role of therapeutic exercises in neurogenic thoracic outlet syndrome. *J Ayub Med Coll Abbottabad*; Oct-Dec 2007.

1910. Kenny, R. A., Traynor, G. B., Withington, D., Keegan, D. J. Thoracic outlet syndrome: a useful exercise treatment option. *Am J Surg*; Feb 1993.

1911. Leffert, R. Thoracic outlet syndrome. *The Hand*; 1991.

1912. Leffert, R. D. Thoracic outlet syndrome. *J Am Acad Orthop Surg*; Nov 1994.

1913. Sucher, B. M. Thoracic outlet syndrome--a myofascial variant: Part 2. Treatment. *J Am Osteopath Assoc*; Sep 1990.

1914. Bilancini, S., Lucchi, M., Tucci, S., Di Rita, L. Postural physiotherapy: a possible conservative treatment of the thoracic outlet syndrome. *Angiologia*; Mar-Apr 1992.

1915. Novak, C. B., Collins, E. D., Mackinnon, S. E. Outcome following conservative management of thoracic outlet syndrome. *J Hand Surg Am*; Jul 1995.

1916. Novak, C. B., Mackinnon, S. E. Thoracic outlet syndrome. *Orthop Clin North Am*; Oct 1996.

1917. Walsh, MT. Therapist's management of brachial plexopathies. *Rehabilitation of the Hand and Upper Extremity. 5th edition.*; 2002.

1918. Tyson, R. R., Kaplan, G. F. Modern concepts of diagnosis and treatment of the thoracic outlet syndrome. *Orthop Clin North Am*; Apr 1975.

1919. Liebenson, C. S. Thoracic outlet syndrome: diagnosis and conservative management. *J Manipulative Physiol Ther*; Dec 1988.

1920. Anthony, MS. Thoracic outlet syndrome. *Hand Rehabilitation: A Practical Guide*; 1993.

1921. Buonocore, M,Manstretta,C,Mazzucchi,G,Casale,R. The clinical evaluation of conservative treatment in patients with the thoracic outlet syndrome. *G Ital Med Lav Ergon*; 1998.

1922. Peng, J. 16 cases of scalenus syndrome treated by massage and acupoint-injection. *J Tradit Chin Med*; Sep 1999.

1923. Gockel, M., Lindholm, H., Vastamaki, M., Lindqvist, A., Viljanen, A. Cardiovascular functional disorder and distress among patients with thoracic outlet syndrome. *J Hand Surg Br*; Feb 1995.

1924. Jamieson, W. G., Chinnick, B. Thoracic outlet syndrome: fact or fancy? A review of 409 consecutive patients who underwent operation. *Can J Surg*; Aug 1996.

1925. Sultan, S., Evoy, D., Eldin, A. S., Eldeeb, M., Elmehairy, N. Atraumatic acute upper limb ischemia: a series of 64 patients in a Middle East tertiary vascular center and literature review. *Vasc Surg*; May-Jun 2001.

1926. Adams, JT, McEvoy, RK, DeWeese, JA. Primary deep venous thrombosis of upper extremity. *Arch Surg*; 1965.

1927. Drapanas, T., Curran, W. L. Thrombectomy in the treatment of "effort" thrombosis of the axillary and subclavian veins. *J Trauma*; Jan 1966.

1928. Swinton, N. W.,Jr., Edgett, J. W.,Jr., Hall, R. J. Primary subclavian-axillary vein thrombosis. *Circulation*; Oct 1968.

1929. Tilney, M. L., Griffiths, H. J., Edwards, E. A. Natural history of major venous thrombosis of the upper extremity. *Arch Surg*; Dec 1970.

1930. Dalal, A. R., Pitney, W. R. Primary thrombosis of the axillary-subclavian veins. *Med J Aust*; Mar 25 1972.

1931. Prescott, S. M., Tikoff, G. Deep venous thrombosis of the upper extremity: a reappraisal. *Circulation*; Feb 1979.

1932. Campbell, C. B., Chandler, J. G., Tegtmeyer, C. J., Bernstein, E. F. Axillary, subclavian, and brachiocephalic vein obstruction. *Surgery*; Dec 1977.

1933. Gloviczki, P, Kazmier, RJ, Hollier, LH. Axillary-subclavian venous occlusion. *J Vasc Surg*; 1986.

1934. Ameli, F. M., Minas, T., Weiss, M., Provan, J. L. Consequences of "conservative" conventional management of axillary vein thrombosis. *Can J Surg*; May 1987.

1935. Brochner, G., Rojas, M., Armas, A. J., Pereira, J. A., Mayall, R. C., Mayall, A. C., Mayall, J. C. Axillary-subclavian venous thrombosis. *J Cardiovasc Surg (Torino)*; Jan-Feb 1989.

1936. de León, RA, Chang, DC, Hassoun, HT, Black, JH, Roseborough, GS, Perler, BA, Rotellini-Coltvet, L, Call, D, Busse, C, Freischlag, JA. Multiple treatment algorithms for successful outcomes in venous thoracic outlet syndrome. *Surgery*; 2009.

1937. Becker, G. J., Holden, R. W., Rabe, F. E., Castaneda-Zuniga, W. R., Sears, N., Dilley, R. S., Glover, J. L. Local thrombolytic therapy for subclavian and axillary vein thrombosis. Treatment of the thoracic inlet syndrome. *Radiology*; Nov 1983.

1938. Taylor, L. M.,Jr., McAllister, W. R., Dennis, D. L., Porter, J. M. Thrombolytic therapy followed by first rib resection for spontaneous ("effort") subclavian vein thrombosis. *Am J Surg*; May 1985.

1939. Druy, EM, Trout, HHIII, Giordano, JM, Hix, WR. Lytic therapy in treatment of axillary and subclavian vein thrombosis. *J Vasc Surg*; 1985.

1940. Vogel, C. M., Jensen, J. E. "Effort" thrombosis of the subclavian vein in a competitive swimmer. *Am J Sports Med*; Jul-Aug 1985.

1941. Smith-Behn, J., Althar, R., Katz, W. Primary thrombosis of the axillary/subclavian vein. *South Med J*; Sep 1986.

1942. Huey, H., Morris, D. C., Nichols, D. M., Connell, D. G., Fry, P. D. Low-dose streptokinase thrombolysis of axillary-subclavian vein thrombosis. *Cardiovasc Intervent Radiol*; 1987.

1943. Landercasper, J., Gall, W., Fischer, M., Boyd, W. C., Dahlberg, P. J., Kisken, W. A., Boland, T. Thrombolytic therapy of axillary-subclavian venous thrombosis. *Arch Surg*; Sep 1987.

1944. O'Leary, M. R., Smith, M. S., Druy, E. M. Diagnostic and therapeutic approach to axillary-subclavian vein thrombosis. *Ann Emerg Med*; Aug 1987.

1945. Shuttleworth, R. D., van der Merwe, D. M., Mitchell, W. L. Subclavian vein stenosis and axillary vein 'effort thrombosis'. Age and the first rib bypass collateral, thrombolytic therapy and first rib resection. *S Afr Med J*; May 2 1987.

1946. Wiles, P. G., Birtwell, A. J., Davies, J. A., Chennells, P. Subclavian vein notch: a phlebographic abnormality associated with subclavian-axillary vein thrombosis. *Br J Hosp Med*; Apr 1987.

1947. DeWeese, J. A., Adams, J. T., Gaiser, D. L. Subclavian venous thrombectomy. *Circulation*; May 1970.

1948. Gaylis, H. A rational approach to venous thrombectomy. *Surg Gynecol Obstet*; Jun 1974.

1949. Dale, W. A. Thoracic outlet compression syndrome. Critique in 1982. *Arch Surg*; Nov 1982.

1950. Mingoli, A., Feldhaus, R. J., Farina, C., Cavallari, N., Sapienza, P., di Marzo, L., Cavallaro, A. Long-term outcome after transaxillary approach for thoracic outlet syndrome. *Surgery*; Nov 1995.

1951. Sanders, R. J., Hammond, S. L. Management of cervical ribs and anomalous first ribs causing neurogenic thoracic outlet syndrome. *J Vasc Surg*; Jul 2002.

1952. Degeorges, R., Reynaud, C., Becquemin, J. P. Thoracic outlet syndrome surgery: long-term functional results. *Ann Vasc Surg*; Sep 2004.

1953. Sharp, W. J., Nowak, L. R., Zamani, T., Kresowik, T. F., Hoballah, J. J., Ballinger, B. A., Corson, J. D. Long-term follow-up and patient satisfaction after surgery for thoracic outlet syndrome. *Ann Vasc Surg*; Jan 2001.

1954. Jacobson, J. H., Haimov, M. Venous revascularization of the arm: report of three cases. *Surgery*; May 1977.

1955. Aziz, S,Straehley,CJ,Whelan,TJ,Jr. Effort-related axillosubclavian vein thrombosis. A new theory of pathogenesis and a plea for direct surgical intervention. *Am J Surg*; 1986.

1956. Inahara, T. Surgical treatment of "effort" thrombosis of the axillary and subclavian veins. *Am Surg*; Jul 1968.

1957. Rabinowitz, R., Goldfarb, D. Surgical treatment of axillosubclavian venous thrombosis: a case report. *Surgery*; Nov 1971.

1958. Pittam, M. R., Darke, S. G. The place of first rib resection in the management of axillary-subclavian vein thrombosis. *Eur J Vasc Surg*; Feb 1987.

1959. Jain, K. M., Smejkal, R. Use of spiral vein graft to bypass occluded subclavian vein. *J Cardiovasc Surg (Torino)*; Sep-Oct 1988.

1960. Etheredge, S., Wilbur, B., Stoney, R. J. Thoracic outlet syndrome. *Am J Surg*; Jul 1979.

1961. Siegel, R. S., Steichen, F. M. Cervicothoracic outlet syndrome. Vascular compression caused by congenital abnormality of thoracic ribs. A case report. *J Bone Joint Surg Am*; Sep 1967.

1962. Adams, JT, DeWeese, JA, Mahoney, EB, Rob, CG. Intermittent subclavian vein obstruction without thrombosis. *Surgery*; 1968.

1963. Gergoudis, R., Barnes, R. W. Thoracic outlet arterial compression: prevalence in normal persons. *Angiology*; Aug 1980.

1964. Urschel, H. C.,Jr., Razzuk, M. A. Improved management of the Paget-Schroetter syndrome secondary to thoracic outlet compression. *Ann Thorac Surg*; Dec 1991.

1965. Pupka, A., Rucinski, A., Skora, J., Janczak, D., Pawlowski, S., Kaluza, G., Dawiskiba, T., Szyber, P. The treatment of subclavian artery compression with the use of ringed polytetrafluoroethylene vascular prostheses. *Polim Med*; 2004.

1966. Mercier, C. The thoraco-brachial passage syndrome. Value of resection of the 1st rib. *Chirurgie*; May 2 1973.

1967. Glass, B. A. The relationship of axillary venous thrombosis to the thoracic outlet compression syndrome. *Ann Thorac Surg*; Jun 1975.

1968. Salo, J. A., Varstela, E., Ketonen, P., Ala-Kulju, K., Luosto, R. Management of vascular complications in thoracic outlet syndrome. *Acta Chir Scand*; May-Jun 1988.

1969. Lord, JW, Urschel, HC Jr. Total claviculectomy. *Surg Rounds*; 1988.

1970. Pairolero, P. C., Walls, J. T., Payne, W. S., Hollier, L. H., Fairbairn, J. F.,2nd. Subclavian-axillary artery aneurysms. *Surgery*; Oct 1981.

1971. McLaughlin, CW, Popma, AM. Intermittent obstruction of the subclavian vein. *JAMA*; 1939.

1972. McCleery, RS, Kesterson, JE, Kirtley, JA, Love, RB. Subclavius and anterior scalene muscle compression as a cause of intermittent obstruction of the subclavian vein. *Ann Surg*; 1951.

1973. Daskalakis, E., Bouhoutsos, J. Subclavian and axillary vein compression of musculoskeletal origin. *Br J Surg*; Aug 1980.

1974. Washington State Department of Labor and Industries, . Medical Treatment Guidelines - Work-Related Neurogenic Thoracic Outlet Syndrome: Diagnosis and Treatment. Available at: http://www.lni.wa.gov/ClaimsIns/Files/OMD/MedTreat/ThoracicOutletNeurogenic.pdf. 2010.

1975. Roos, D. B. Transaxillary approach for first rib resection to relieve thoracic outlet syndrome. *Ann Surg*; Mar 1966.

1976. Murphy, T. Brachial neuritis caused by pressure of first rib. *Aust Med J*; 1910.

1977. Clagett, 0T. Presidential address: research and prosearch. *J Thoracic Cardiovascular Surg*; 1962.

1978. Molina, J. E. Combined posterior and transaxillary approach for neurogenic thoracic outlet syndrome. *J Am Coll Surg*; Jul 1998.

1979. Edwards, D. P., Mulkern, E., Raja, A. N., Barker, P. Trans-axillary first rib excision for thoracic outlet syndrome. *J R Coll Surg Edinb*; Dec 1999.

1980. Toso, C., Robert, J., Berney, T., Pugin, F., Spiliopoulos, A. Thoracic outlet syndrome: influence of personal history and surgical technique on long-term results. *Eur J Cardiothorac Surg*; Jul 1999.

1981. McCarthy, M. J., Varty, K., London, N. J., Bell, P. R. Experience of supraclavicular exploration and decompression for treatment of thoracic outlet syndrome. *Ann Vasc Surg*; May 1999.

1982. Sanders, R. J. Results of the surgical treatment for thoracic outlet syndrome. *Semin Thorac Cardiovasc Surg*; Apr 1996.

1983. Donaghy, M., Matkovic, Z., Morris, P. Surgery for suspected neurogenic thoracic outlet syndromes: a follow up study. *J Neurol Neurosurg Psychiatry*; Nov 1999.

1984. Mattson, R. J. Surgical approach to anterior scalenectomy. *Hand Clin*; Feb 2004.

1985. Qvarfordt, P. G., Ehrenfeld, W. K., Stoney, R. J. Supraclavicular radical scalenectomy and transaxillary first rib resection for the thoracic outlet syndrome. A combined approach. *Am J Surg*; Jul 1984.

1986. Roos, D. B. The place for scalenectomy and first-rib resection in thoracic outlet syndrome. *Surgery*; Dec 1982.

1987. Sheth, R. N., Campbell, J. N. Surgical treatment of thoracic outlet syndrome: a randomized trial comparing two operations. *J Neurosurg Spine*; Nov 2005.

1988. Mailis, A., Papagapiou, M., Vanderlinden, R. G., Campbell, V., Taylor, A. Thoracic outlet syndrome after motor vehicle accidents in a Canadian pain clinic population. *Clin J Pain*; Dec 1995.

1989. Atasoy, E. Recurrent thoracic outlet syndrome. *Hand Clin*; 2004.

1990. Kirkley, A., Griffin, S., Richards, C., Miniaci, A., Mohtadi, N. Prospective randomized clinical trial comparing the effectiveness of immediate arthroscopic stabilization versus immobilization and rehabilitation in first traumatic anterior dislocations of the shoulder. *Arthroscopy*; Jul-Aug 1999.

1991. Reinold, M. M., Wilk, K. E., Hooks, T. R., Dugas, J. R., Andrews, J. R. Thermal-assisted capsular shrinkage of the glenohumeral joint in overhead athletes: a 15- to 47-month follow-up. *J Orthop Sports Phys Ther*; Aug 2003.

1992. Kakar, S., Voloshin, I., Kaye, E. K., Crivello, K., Edgar, C. M., Edmond, C. M., Pryor, J. D., Schepsis, A. A. Posterior shoulder instability: comprehensive analysis of open and arthroscopic approaches. *Am J Orthop*; Dec 2007.

1993. Hovelius, L. Anterior dislocation of the shoulder in teen-agers and young adults. Five-year prognosis. *J Bone Joint Surg Am*; Mar 1987.

1994. Simonet, W. T., Melton, L. J.,3rd, Cofield, R. H., Ilstrup, D. M. Incidence of anterior shoulder dislocation in Olmsted County, Minnesota. *Clinical Orthopaedics And Related Research*; Jun 1984.

1995. Kirkley, S. Primary anterior dislocation of the shoulder in young patients. A ten-year prospective study. *J Bone Joint Surg Am*; Feb 1998.

1996. Good, C. R., MacGillivray, J. D. Traumatic shoulder dislocation in the adolescent athlete: advances in surgical treatment. *Curr Opin Pediatr*; Feb 2005.

1997. Dalton, S. E., Snyder, S. J. Glenohumeral instability. *Baillieres Clin Rheumatol*; Dec 1989.

1998. Aronen, J. G., Regan, K. Decreasing the incidence of recurrence of first time anterior shoulder dislocations with rehabilitation. *Am J Sports Med*; Jul-Aug 1984.

1999. Burkhead, W. Z.,Jr., Rockwood, C. A.,Jr. Treatment of instability of the shoulder with an exercise program. *J Bone Joint Surg Am*; Jul 1992.

2000. Hovelius, L., Augustini, B. G., Fredin, H., Johansson, O., Norlin, R., Thorling, J. Primary anterior dislocation of the shoulder in young patients. A ten-year prospective study. *J Bone Joint Surg Am*; Nov 1996.

2001. Liu, S. H., Henry, M. H., Nuccion, S., Shapiro, M. S., Dorey, F. Diagnosis of glenoid labral tears. A comparison between magnetic resonance imaging and clinical examinations. *Am J Sports Med*; Mar-Apr 1996.

2002. Line, L, Murret, L. Labral tears: diagnosis, treatment and rehabilitation. *Athletic Therapy Today*; Jul 1999.

2003. Wen, D. Y. Current concepts in the treatment of anterior shoulder dislocations. *Am J Emerg Med*; Jul 1999.

2004. Bottoni, C. R., Wilckens, J. H., DeBerardino, T. M., D'Alleyrand, J. C., Rooney, R. C., Harpstrite, J. K., Arciero, R. A. A prospective, randomized evaluation of arthroscopic stabilization versus nonoperative treatment in patients with acute, traumatic, first-time shoulder dislocations. *Am J Sports Med*; Jul-Aug 2002.

2005. Kirkley, A., Werstine, R., Ratjek, A., Griffin, S. Prospective randomized clinical trial comparing the effectiveness of immediate arthroscopic stabilization versus immobilization and rehabilitation in first traumatic anterior dislocations of the shoulder: long-term evaluation. *Arthroscopy*; Jan 2005.

2006. Jakobsen, B. W., Johannsen, H. V., Suder, P., Sojbjerg, J. O. Primary repair versus conservative treatment of first-time traumatic anterior dislocation of the shoulder: a randomized study with 10-year follow-up. *Arthroscopy*; Feb 2007.

2007. Robinson, C. M., Jenkins, P. J., White, T. O., Ker, A., Will, E. Primary arthroscopic stabilization for a first-time anterior dislocation of the shoulder. A randomized, double-blind trial. *J Bone Joint Surg Am*; Apr 2008.

2008. Larrain, M. V., Botto, G. J., Montenegro, H. J., Mauas, D. M. Arthroscopic repair of acute traumatic anterior shoulder dislocation in young athletes. *Arthroscopy*; Apr 2001.

2009. Edmonds, G., Kirkley, A., Birmingham, T. B., Fowler, P. J. The effect of early arthroscopic stabilization compared to nonsurgical treatment on proprioception after primary traumatic anterior dislocation of the shoulder. *Knee Surg Sports Traumatol Arthrosc*; Mar 2003.

2010. Rowe, C. R. Prognosis in dislocations of the shoulder. *The Journal Of Bone And Joint Surgery American Volume*; Oct 1956.

2011. McLaughlin, H. L., MacLellan, D. I. Recurrent anterior dislocation of the shoulder. II. A comparative study. *J Trauma*; Mar 1967.

2012. Kazar, B., Relovszky, E. Prognosis of primary dislocation of the shoulder. *Acta Orthop Scand*; 1969.

2013. Rowe, C. R., Patel, D., Southmayd, W. W. The Bankart procedure: a long-term end-result study. *J Bone Joint Surg Am*; Jan 1978.

2014. Kiviluoto, O., Pasila, M., Jaroma, H., Sundholm, A. Immobilization after primary dislocation of the shoulder. *Acta Orthop Scand*; Dec 1980.

2015. Yoneda, . Conservative treatment of shoulder dislocation in young males. *J Bone Joint Surg*; 1982.

2016. Hovelius, L., Eriksson, K., Fredin, H., Hagberg, G., Hussenius, A., Lind, B., Thorling, J., Weckstrom, J. Recurrences after initial dislocation of the shoulder. Results of a prospective study of treatment. *J Bone Joint Surg Am*; Mar 1983.

2017. Hovelius, L., Lind, B., Thorling, J. Primary dislocation of the shoulder. Factors affecting the two-year prognosis. *Clin Orthop Relat Res*; Jun 1983.

2018. Hovelius, L. Shoulder dislocation in Swedish ice hockey players. *Am J Sports Med*; Nov-Dec 1978.

2019. Thomas, S. C., Matsen, F. A.,3rd. An approach to the repair of avulsion of the glenohumeral ligaments in the management of traumatic anterior glenohumeral instability. *The Journal Of Bone And Joint Surgery American Volume*; Apr 1989.

2020. Wheeler, J. H., Ryan, J. B., Arciero, R. A., Molinari, R. N. Arthroscopic versus nonoperative treatment of acute shoulder dislocations in young athletes. *Arthroscopy*; 1989.

2021. Hoelen, M. A., Burgers, A. M., Rozing, P. M. Prognosis of primary anterior shoulder dislocation in young adults. *Arch Orthop Trauma Surg*; 1990.

2022. Arciero, R. A., Wheeler, J. H., Ryan, J. B., McBride, J. T. Arthroscopic Bankart repair versus nonoperative treatment for acute, initial anterior shoulder dislocations. *Am J Sports Med*; Sep-Oct 1994.

2023. Arciero, R. A., St Pierre, P. Acute shoulder dislocation. Indications and techniques for operative management. *Clin Sports Med*; Oct 1995.

2024. DeBerardino, T. M., Arciero, R. A., Taylor, D. C. Arthroscopic stabilization of acute initial anterior shoulder dislocation: the West Point experience. *J South Orthop Assoc*; Winter 1996.

2025. DeBerardino, T. M., Arciero, R. A., Taylor, D. C., Uhorchak, J. M. Prospective evaluation of arthroscopic stabilization of acute, initial anterior shoulder dislocations in young athletes. Two- to five-year follow-up. *Am J Sports Med*; Sep-Oct 2001.

2026. Salmon, J. M., Bell, S. N. Arthroscopic stabilization of the shoulder for acute primary dislocations using a transglenoid suture technique. *Arthroscopy*; Mar 1998.

2027. Valentin, A., Winge, S., Engstrom, B. Early arthroscopic treatment of primary traumatic anterior shoulder dislocation. A follow-up study. *Scand J Med Sci Sports*; Dec 1998.

2028. O'Neill, D. B. Arthroscopic Bankart repair of anterior detachments of the glenoid labrum. A prospective study. *J Bone Joint Surg Am*; Oct 1999.

2029. Wintzell, G., Haglund-Akerlind, Y., Ekelund, A., Sandstrom, B., Hovelius, L., Larsson, S. Arthroscopic lavage reduced the recurrence rate following primary anterior shoulder dislocation. A randomised multicentre study with 1-year follow-up. *Knee Surg Sports Traumatol Arthrosc*; 1999.

2030. Handoll, H. H., Almaiyah, M. A., Rangan, A. Surgical versus non-surgical treatment for acute anterior shoulder dislocation. *Cochrane Database Syst Rev*; 2004.

2031. Brophy, R. H., Marx, R. G. The treatment of traumatic anterior instability of the shoulder: nonoperative and surgical treatment. *Arthroscopy*; Mar 2009.

2032. Hurley, ET,Manjunath,AK,Bloom,DA,et al. Arthroscopic Bankart Repair Versus Conservative Management for First-Time Traumatic Anterior Shoulder Instability: A Systematic Review and Meta-analysis. *Arthroscopy*; 2020.

2033. van Spanning, SH,Verweij,LPE,Priester-Vink,S,et al. Operative Versus Nonoperative Treatment Following First-Time Anterior Shoulder Dislocation: A Systematic Review and Meta-Analysis. *JBJS Rev*; 2021.

2034. Stefko, J. M., Tibone, J. E., Cawley, P. W., ElAttrache, N. E., McMahon, P. J. Strain of the anterior band of the inferior glenohumeral ligament during capsule failure. *J Shoulder Elbow Surg*; Sep-Oct 1997.

2035. Taylor, D. C., Arciero, R. A. Pathologic changes associated with shoulder dislocations. Arthroscopic and physical examination findings in first-time, traumatic anterior dislocations. *Am J Sports Med*; May-Jun 1997.

2036. Angelo, R. L. Controversies in arthroscopic shoulder surgery: arthroscopic versus open bankart repair, thermal treatment of capsular tissue, acromioplasties--are they necessary? *Arthroscopy*; Dec 2003.

2037. Morgan, C. D., Bodenstab, A. B. Arthroscopic Bankart suture repair: technique and early results. *Arthroscopy*; 1987.

2038. Wiley, A. M. Arthroscopy for shoulder instability and a technique for arthroscopic repair. *Arthroscopy*; 1988.

2039. Wolf, E. Arthroscopic anterior shoulder capsulorrhaphy. *Techniques in Orthopaedics*; 1988.

2040. Caspari, R. B. Arthroscopy--an orthopaedic surgical subspecialty or a technique? *Arthroscopy*; 1991.

2041. Coughlin, L., Rubinovich, M., Johansson, J., White, B., Greenspoon, J. Arthroscopic staple capsulorrhaphy for anterior shoulder instability. *Am J Sports Med*; May-Jun 1992.

2042. Landsiedl, F. Arthroscopic therapy of recurrent anterior luxation of the shoulder by capsular repair. *Arthroscopy*; 1992.

2043. Grana, W. A., Buckley, P. D., Yates, C. K. Arthroscopic Bankart suture repair. *Am J Sports Med*; May-Jun 1993.

2044. Hurley, J., Bronstein, R. Shoulder arthroscopy in the athlete. Practical applications. *Sports Med*; Feb 1993.

2045. Lane, J. G., Sachs, R. A., Riehl, B. Arthroscopic staple capsulorrhaphy: a long-term follow-up. *Arthroscopy*; 1993.

2046. Altchek, D. W. Arthroscopy of the shoulder. *Scand J Med Sci Sports*; Apr 1995.

2047. Hintermann, B., Gachter, A. Arthroscopic findings after shoulder dislocation. *Am J Sports Med*; Sep-Oct 1995.

2048. Sandow, M. J. Arthroscopic repair for primary shoulder dislocation: A randomized clinical trial. *J Bone Joint Surg Br*; 1995.

2049. Swenson, T. M., Warner, J. J. Arthroscopic shoulder stabilization. Overview of indications, technique, and efficacy. *Clin Sports Med*; Oct 1995.

2050. Walch, G., Boileau, P., Levigne, C., Mandrino, A., Neyret, P., Donell, S. Arthroscopic stabilization for recurrent anterior shoulder dislocation: results of 59 cases. *Arthroscopy*; Apr 1995.

2051. Wall, M. S., O'Brien, S. J. Arthroscopic evaluation of the unstable shoulder. *Clin Sports Med*; Oct 1995.

2052. Guanche, C. A., Quick, D. C., Sodergren, K. M., Buss, D. D. Arthroscopic versus open reconstruction of the shoulder in patients with isolated Bankart lesions. *Am J Sports Med*; Mar-Apr 1996.

2053. Long, J. S. Shoulder arthroscopy. *Orthop Nurs*; Mar-Apr 1996.

2054. Rose, D. J. Arthroscopic transglenoid suture capsulorrhaphy for anterior shoulder instability. *Instr Course Lect*; 1996.

2055. Sandow, MJ. Acute arthroscopic Bankart repair for initial anterior shoulder dislocation: a prospective clinical trial. *J Shoulder Elbow Surg*; 1996.

2056. Geiger, D. F., Hurley, J. A., Tovey, J. A., Rao, J. P. Results of arthroscopic versus open Bankart suture repair. *Clin Orthop Relat Res*; Apr 1997.

2057. McIntyre, L. F., Caspari, R. B., Savoie, F. H. The arthroscopic treatment of anterior and multidirectional shoulder instability. *Instr Course Lect*; 1996.

2058. Resch, H., Povacz, P., Wambacher, M., Sperner, G., Golser, K. Arthroscopic extra-articular Bankart repair for the treatment of recurrent anterior shoulder dislocation. *Arthroscopy*; Apr 1997.

2059. Copeland, S. Arthroscopy and arthroscopic surgery of the shoulder. *Br J Theatre Nurs*; Jun 1998.

2060. Steinbeck, J., Liljenqvist, U., Jerosch, J. The anatomy of the glenohumeral ligamentous complex and its contribution to anterior shoulder stability. *J Shoulder Elbow Surg*; Mar-Apr 1998.

2061. De Mulder, K., Petre, D., Declercq, G. Arthroscopy of the shoulder. Current concepts review. *Acta Orthop Belg*; Dec 1999.

2062. Antoniou, J., Harryman, D. T.,2nd. Arthroscopic posterior capsular repair. *Clin Sports Med*; Jan 2000.

2063. Cole, B. J., Warner, J. J. Arthroscopic versus open Bankart repair for traumatic anterior shoulder instability. *Clin Sports Med*; Jan 2000.

2064. Nelson, B. J., Arciero, R. A. Arthroscopic management of glenohumeral instability. *Am J Sports Med*; Jul-Aug 2000.

2065. Mayfield, J. B., Carter, C., Wang, C., Warner, J. J. Arthroscopic shoulder reconstruction: fast-track recovery and outpatient treatment. *Clin Orthop Relat Res*; Sep 2001.

2066. Rook, R. T., Savoie, F. H.,3rd, Field, L. D. Arthroscopic treatment of instability attributable to capsular injury or laxity. *Clin Orthop Relat Res*; Sep 2001.

2067. Nebelung, W., Jaeger, A., Wiedemann, E. Rationales of arthroscopic shoulder stabilization. *Arch Orthop Trauma Surg*; Nov 2002.

2068. Stein, D. A., Jazrawi, L., Bartolozzi, A. R. Arthroscopic stabilization of anterior shoulder instability: a review of the literature. *Arthroscopy*; Oct 2002.

2069. Millett, P. J., Clavert, P., Warner, J. J. Arthroscopic management of anterior, posterior, and multidirectional shoulder instability: pearls and pitfalls. *Arthroscopy*; Dec 2003.

2070. Ryu, R. K. Arthroscopic approach to traumatic anterior shoulder instability. *Arthroscopy*; Dec 2003.

2071. Stokes, D. A., Savoie, F. H.,3rd, Field, L. D., Ramsey, J. R. Arthroscopic repair of anterior glenohumeral instability and rotator interval lesions. *Orthop Clin North Am*; Oct 2003.

2072. Chen, L,Xu,Z,Peng,J,et al. Effectiveness and safety of arthroscopic versus open Bankart repair for recurrent anterior shoulder dislocation: a meta-analysis of clinical trial data. *Arch Orthopaedic Trauma Surg*; 2015.

2073. Freedman, K. B., Smith, A. P., Romeo, A. A., Cole, B. J., Bach, B. R.,Jr. Open Bankart repair versus arthroscopic repair with transglenoid sutures or bioabsorbable tacks for Recurrent Anterior instability of the shoulder: a meta-analysis. *Am J Sports Med*; Sep 2004.

2074. Robinson, C. M., Dobson, R. J. Anterior instability of the shoulder after trauma. *J Bone Joint Surg Br*; May 2004.

2075. Levine, W. N., Rieger, K., McCluskey, G. M.,3rd. Arthroscopic treatment of anterior shoulder instability. *Instr Course Lect*; 2005.

2076. Budoff, J. E., Wolf, E. M. Arthroscopic treatment of glenohumeral instability. *J Hand Surg Am*; Oct 2006.

2077. Hobby, J., Griffin, D., Dunbar, M., Boileau, P. Is arthroscopic surgery for stabilisation of chronic shoulder instability as effective as open surgery? A systematic review and meta-analysis of 62 studies including 3044 arthroscopic operations. *J Bone Joint Surg Br*; Sep 2007.

2078. Kropf, E. J., Tjoumakaris, F. P., Sekiya, J. K. Arthroscopic shoulder stabilization: is there ever a need to open? *Arthroscopy*; Jul 2007.

2079. Pulavarti, RS, Symes, TH, Rangan, A. Surgical interventions for shoulder instability in adults. *Cochrane Database Syst Rev*; 2009.

2080. Friedman, L. G., Griesser, M. J., Miniaci, A. A., Jones, M. H. Recurrent instability after revision anterior shoulder stabilization surgery. *Arthroscopy*; Mar 2014.

2081. Bankart, A. The pathology and treatment of recurrent dislocation of the shoulder-joint. *British Journal of Surgery*; 1938.

2082. Hovelius, L., Thorling, J., Fredin, H. Recurrent anterior dislocation of the shoulder. Results after the Bankart and Putti-Platt operations. *J Bone Joint Surg Am*; Jun 1979.

2083. Ejerhed, L., Kartus, J., Funck, E., Kohler, K., Sernert, N., Karlsson, J. A clinical and radiographic comparison of absorbable and non-absorbable suture anchors in open shoulder stabilisation. *Knee Surg Sports Traumatol Arthrosc*; 2000.

2084. Itoi, E., Watanabe, W., Yamada, S., Shimizu, T., Wakabayashi, I. Range of motion after Bankart repair. Vertical compared with horizontal capsulotomy. *Am J Sports Med*; Jul-Aug 2001.

2085. Karlsson, J., Magnusson, L., Ejerhed, L., Hultenheim, I., Lundin, O., Kartus, J. Comparison of open and arthroscopic stabilization for recurrent shoulder dislocation in patients with a Bankart lesion. *Am J Sports Med*; Sep-Oct 2001.

2086. Caprise, P. A.,Jr., Sekiya, J. K. Open and arthroscopic treatment of multidirectional instability of the shoulder. *Arthroscopy*; Oct 2006.

2087. Provencher, M. T., Romeo, A. A. Posterior and multidirectional instability of the shoulder: challenges associated with diagnosis and management. *Instr Course Lect*; 2008.

2088. Handoll, Helen, Brealey, Stephen, Rangan, Amar, Keding, Ada, Corbacho, Belen, Jefferson, Laura, Chuang, Ling-Hsiang, Goodchild, Lorna, Hewitt, Catherine, Torgerson, David. The ProFHER (PROximal Fracture of the Humerus: Evaluation by Randomisation) trial-a pragmatic multicentre randomised controlled trial evaluating the clinical effectiveness and cost-effectiveness of surgical compared with non-surgical treatment for proximal fracture of the humerus in adults. *Health Technology Assessment (Winchester, England)*; 2015.

2089. Sperber, A., Hamberg, P., Karlsson, J., Sward, L., Wredmark, T. Comparison of an arthroscopic and an open procedure for posttraumatic instability of the shoulder: a prospective, randomized multicenter study. *J Shoulder Elbow Surg*; Mar-Apr 2001.

2090. Fabbriciani, C., Milano, G., Demontis, A., Fadda, S., Ziranu, F., Mulas, P. D. Arthroscopic versus open treatment of Bankart lesion of the shoulder: a prospective randomized study. *Arthroscopy: The Journal Of Arthroscopic & Related Surgery: Official Publication Of The Arthroscopy Association Of North America And The International Arthroscopy Association*; May 2004.

2091. Rhee, Y. G., Lim, C. T., Cho, N. S. Muscle strength after anterior shoulder stabilization: arthroscopic versus open Bankart repair. *Am J Sports Med*; Nov 2007.

2092. Flatow, EL,Warner,JI. Instability of the shoulder: Complex problems and failedrepairs. Part I: Relevant biomechanics, multidirectional instability, and severe glenoid loss. *Instr Course Lect*; 1998.

2093. Armitage, MS,Faber,KJ,Drosdowech,DS,et al. Humeral head bone defects: Remplissage, allograft, and arthroplasty. *Orthop Clin North Am*; 2010.

2094. Provencher, M,Frank,R,Leclere,L,et al. The Hill-Sachs lesion: diagnosis, classification, and management. *J Am Acad Orthop Surg*; 2012.

2095. Gulati, A,Dessouky,R,Wadhwa,V,et al. New concepts of radiologic preoperative evaluation of anterior shoulder instability: On-track and off-track lesions. *Acta Radiologica*; 2017.

2096. Boileau, P,O'Shea,K,Vargas,P,et al. Anatomical and functional results after arthroscopic Hill- sachs remplissage. *J Bone Joint Surg Am*; 2012.

2097. Cowling, P,Akhtar,M,Liow,R. What is a Bristow-Latarjet procedure? *J Bone Joint Surg Am*; 2016.

2098. Allain, J,Goutallier,D,Glorion,C. Long-term results of the Latarjet procedure for the treatment of anterior instability of the shoulder. *J Bone Joint Surg Am*; 1998.

2099. Garcia, G,Wu,H,Liu,J,et al. Outcomes of the remplissage procedure and its effects of return to sports: Average 5- year follow-up. *Am J Sports Med*; 2016.

2100. Altchek, D. W., Warren, R. F., Wickiewicz, T. L., Ortiz, G. Arthroscopic labral debridement. A three-year follow-up study. *Am J Sports Med*; Nov-Dec 1992.

2101. Cordasco, FA, Steinmann, S, Flatow, EL, Bigliani, LU. Arthroscopic treatment of glenoid labral tears. including commentary by Warren RF. *American Journal of Sports Medicine*; 1993.

2102. Resch, H, Golser, K, Thoeni, H, Sperner, G. Arthroscopic repair of superior glenoid labral detachment (the SLAP lesion). *Journal of Shoulder and Elbow surgery*; 1993.

2103. Payne, L. Z. Tears of the glenoid labrum. *Orthop Rev*; Jul 1994.

2104. Warner, J. J., Kann, S., Marks, P. Arthroscopic repair of combined Bankart and superior labral detachment anterior and posterior lesions: technique and preliminary results. *Arthroscopy*; Aug 1994.

2105. Snyder, S. J., Banas, M. P., Karzel, R. P. An analysis of 140 injuries to the superior glenoid labrum. *J Shoulder Elbow Surg*; Jul-Aug 1995.

2106. Segmuller, H. E., Hayes, M. G., Saies, A. D. Arthroscopic repair of glenolabral injuries with an absorbable fixation device. *J Shoulder Elbow Surg*; Jul-Aug 1997.

2107. Handelberg, F., Willems, S., Shahabpour, M., Huskin, J. P., Kuta, J. SLAP lesions: a retrospective multicenter study. *Arthroscopy*; Nov-Dec 1998.

2108. Pearce, C. E., Burkhart, S. S. The pitcher's mound: a late sequela of posterior type II SLAP lesions. *Arthroscopy*; Mar 2000.

2109. Parentis, M. A., Mohr, K. J., ElAttrache, N. S. Disorders of the superior labrum: review and treatment guidelines. *Clinical Orthopaedics And Related Research*; Jul 2002.

2110. Kim, Tae Kyun, Queale, William S., Cosgarea, Andrew J., McFarland, Edward G. Clinical features of the different types of slap lesions. *J Bone Joint Surg Am*; 2003.

2111. Andrews, J. R., Carson, W. G.,Jr., McLeod, W. D. Glenoid labrum tears related to the long head of the biceps. *Am J Sports Med*; Sep-Oct 1985.

2112. Snyder, S. J., Karzel, R. P., Del Pizzo, W., Ferkel, R. D., Friedman, M. J. SLAP lesions of the shoulder. *Arthroscopy: The Journal Of Arthroscopic & Related Surgery: Official Publication Of The Arthroscopy Association Of North America And The International Arthroscopy Association*; 1990.

2113. Kippe, MA, Nguyen, D, Ahmad, CS. Percutaneous techniques for shoulder labral repair. *Operative Techniques in Sports Medicine*; Jul 2007.

2114. Beltran, J., Jbara, M., Maimon, R. Shoulder: labrum and bicipital tendon. *Top Magn Reson Imaging*; Feb 2003.

2115. Maffet, M. W., Gartsman, G. M., Moseley, B. Superior labrum-biceps tendon complex lesions of the shoulder. *Am J Sports Med*; Jan-Feb 1995.

2116. Mileski, R. A., Snyder, S. J. Superior labral lesions in the shoulder: pathoanatomy and surgical management. *J Am Acad Orthop Surg*; Mar-Apr 1998.

2117. Levine, W. N., Flatow, E. L. The pathophysiology of shoulder instability. *Am J Sports Med*; Nov-Dec 2000.

2118. Sayde, W. M., Cohen, S. B., Ciccotti, M. G., Dodson, C. C. Return to play after Type II superior labral anterior-posterior lesion repairs in athletes: a systematic review. *Clin Orthop Relat Res*; Jun 2012.

2119. Edwards, S. L., Lee, J. A., Bell, J. E., Packer, J. D., Ahmad, C. S., Levine, W. N., Bigliani, L. U., Blaine, T. A. Nonoperative treatment of superior labrum anterior posterior tears: improvements in pain, function, and quality of life. *Am J Sports Med*; Jul 2010.

2120. Franceschi, F., Longo, U. G., Ruzzini, L., Rizzello, G., Maffulli, N., Denaro, V. No advantages in repairing a type II superior labrum anterior and posterior (SLAP) lesion when associated with rotator cuff repair in patients over age 50: a randomized controlled trial. *Am J Sports Med*; Feb 2008.

2121. Provencher, M. T., McCormick, F., Dewing, C., McIntire, S., Solomon, D. A prospective analysis of 179 type 2 superior labrum anterior and posterior repairs: outcomes and factors associated with success and failure. *Am J Sports Med*; Apr 2013.

2122. Alpert, J. M., Wuerz, T. H., O'Donnell, T. F., Carroll, K. M., Brucker, N. N., Gill, T. J. The effect of age on the outcomes of arthroscopic repair of type II superior labral anterior and posterior lesions. *Am J Sports Med*; Nov 2010.

2123. Maurer, S. G., Rosen, J. E., Bosco, J. A.,3rd. SLAP lesions of the shoulder. *Bull Hosp Jt Dis*; 2003.

2124. Boss, A. P., Maurer, T., Seiler, S., Aeschbach, A., Hintermann, B., Strebel, S. Continuous subacromial bupivacaine infusion for postoperative analgesia after open acromioplasty and rotator cuff repair: preliminary results. *J Shoulder Elbow Surg*; Nov-Dec 2004.

2125. Bedi, A., Allen, A. A. Superior labral lesions anterior to posterior-evaluation and arthroscopic management. *Clin Sports Med*; Oct 2008.

2126. Gartsman, G. M., Hammerman, S. M. Superior labrum, anterior and posterior lesions. When and how to treat them. *Clin Sports Med*; Jan 2000.

2127. Craig, E. V. Shoulder arthroscopy in the throwing athlete. *Clin Sports Med*; Oct 1996.

2128. Morey, VM, Singh, H, Paladini, P, Merolla, G, Phadke, V, Porcellini, G. The Porcellini test: a novel test for accurate diagnosis of posterior labral tears of the shoulder: comparative analysis with the established tests. *Musculoskeletal surgery*; 2016.

2129. Pinto, MC, Snyder, SJ. Slap lesions: current operative techniques and management. *Operative Techniques in Orthopaedics*; 2001.

2130. Westerheide, K. J., Karzel, R. P. Ganglion cysts of the shoulder: technique of arthroscopic decompression and fixation of associated type II superior labral anterior to posterior lesions. *Orthop Clin North Am*; Oct 2003.

2131. Brockmeier, SF, Voos, JE, Williams Iii, RJ, Aitchek, DW, Cordasco, FA, Allen, AA. Outcomes after arthroscopic repair of Type-II SLAP lesions. *J Bone Joint Surg Am*; 2009.

2132. Yian, E., Wang, C., Millett, P. J., Warner, J. J. Arthroscopic repair of SLAP lesions with a bioknotless suture anchor. *Arthroscopy: The Journal Of Arthroscopic & Related Surgery: Official Publication Of The Arthroscopy Association Of North America And The International Arthroscopy Association*; May 2004.

2133. Cohen, D. B., Coleman, S., Drakos, M. C., Allen, A. A., O'Brien, S. J., Altchek, D. W., Warren, R. F. Outcomes of isolated type II SLAP lesions treated with arthroscopic fixation using a bioabsorbable tack. *Arthroscopy: The Journal Of Arthroscopic & Related Surgery: Official Publication Of The Arthroscopy Association Of North America And The International Arthroscopy Association*; Feb 2006.

2134. Gregush, R. V., Snyder, S. J. Superior labral repair. *Sports Med Arthrosc*; Dec 2007.

2135. Oh, J. H., Kim, J. Y., Choi, J. H., Park, S. M. Is arthroscopic distal clavicle resection necessary for patients with radiological acromioclavicular joint arthritis and rotator cuff tears? A prospective randomized comparative study. *Am J Sports Med*; Nov 2014.

2136. Yung, P. S., Fong, D. T., Kong, M. F., Lo, C. K., Fung, K. Y., Ho, E. P., Chan, D. K., Chan, K. M. Arthroscopic repair of isolated type II superior labrum anterior-posterior lesion. *Knee Surgery, Sports Traumatology, Arthroscopy: Official Journal Of The ESSKA*; Dec 2008.

2137. Kartus, J., Ejerhed, L., Funck, E., Kohler, K., Sernert, N., Karlsson, J. Arthroscopic and open shoulder stabilization using absorbable implants. A clinical and radiographic comparison of two methods. *Knee Surgery, Sports Traumatology, Arthroscopy: Official Journal Of The ESSKA*; 1998.

2138. Yoneda, M., Hirooka, A., Saito, S., Yamamoto, T., Ochi, T., Shino, K. Arthroscopic stapling for detached superior glenoid labrum. *J Bone Joint Surg Br*; Sep 1991.

2139. Field, L. D., Savoie, F. H.,3rd. Arthroscopic suture repair of superior labral detachment lesions of the shoulder. *Am J Sports Med*; Nov-Dec 1993.

2140. Rhee, Y. G., Lee, D. H., Lim, C. T. Unstable isolated SLAP lesion: clinical presentation and outcome of arthroscopic fixation. *Arthroscopy: The Journal Of Arthroscopic & Related Surgery: Official Publication Of The Arthroscopy Association Of North America And The International Arthroscopy Association*; Sep 2005.

2141. Katz, L. M., Hsu, S., Miller, S. L., Richmond, J. C., Ketia, E., Kohli, N., Curtis, A. S. Poor outcomes after SLAP repair: descriptive analysis and prognosis. *Arthroscopy: The Journal Of Arthroscopic & Related Surgery: Official Publication Of The Arthroscopy Association Of North America And The International Arthroscopy Association*; Aug 2009.

2142. Verma, N. N., Garretson, R., Romeo, A. A. Outcome of arthroscopic repair of Type II SLAP lesions in worker's compensation patients. *HSS Journal: The Musculoskeletal Journal Of Hospital For Special Surgery*; Feb 2007.

2143. Rames, R. D., Karzel, R. P. Injuries to the glenoid labrum, including slap lesions. *Orthop Clin North Am*; Jan 1993.

2144. Grauer, J. D., Paulos, L. E., Smutz, W. P. Biceps tendon and superior labral injuries. *Arthroscopy*; 1992.

2145. Pagnani, M. J., Speer, K. P., Altchek, D. W., Warren, R. F., Dines, D. M. Arthroscopic fixation of superior labral lesions using a biodegradable implant: a preliminary report. *Arthroscopy*; Apr 1995.

2146. Boileau, Pascal, Parratte, Sebastien, Chuinard, Christopher, Roussanne, Yannick, Shia, Derek, Bicknell, Ryan. Arthroscopic Treatment of Isolated Type II SLAP Lesions: Biceps Tenodesis as an Alternative to Reinsertion. *American Journal of Sports Medicine*; May 2009.

2147. Baker, C. L.,3rd, Romeo, A. A. Combined arthroscopic repair of a type IV SLAP tear and Bankart lesion. *Arthroscopy*; Sep 2009.

2148. Powers, J. A., Bach, P. J. Acromioclavicular separations. Closed or open treatment? *Clin Orthop Relat Res*; Oct 1974.

2149. Larsen, E., Bjerg-Nielsen, A., Christensen, P. Conservative or surgical treatment of acromioclavicular dislocation. A prospective, controlled, randomized study. *J Bone Joint Surg Am*; Apr 1986.

2150. Taft, T. N., Wilson, F. C., Oglesby, J. W. Dislocation of the acromioclavicular joint. An end-result study. *J Bone Joint Surg Am*; Sep 1987.

2151. Bannister, G. C., Wallace, W. A., Stableforth, P. G., Hutson, M. A. The management of acute acromioclavicular dislocation. A randomised prospective controlled trial. *J Bone Joint Surg Br*; Nov 1989.

2152. Mignani, G., Rotini, R., Olmi, R., Marchiodi, L., Veronesi, C. A. The surgical treatment of Rockwood grade III acromioclavicular dislocations. *Chir Organi Mov*; Jul-Sep 2002.

2153. Phillips, A. M., Smart, C., Groom, A. F. Acromioclavicular dislocation. Conservative or surgical therapy. *Clin Orthop Relat Res*; Aug 1998.

2154. Skjeldal, S., Lundblad, R., Dullerud, R. Coracoid process transfer for acromioclavicular dislocation. *Acta Orthop Scand*; Apr 1988.

2155. MacDonald, P. B., Alexander, M. J., Frejuk, J., Johnson, G. E. Comprehensive functional analysis of shoulders following complete acromioclavicular separation. *Am J Sports Med*; Sep-Oct 1988.

2156. Lancaster, S., Horowitz, M., Alonso, J. Complete acromioclavicular separations. A comparison of operative methods. *Clin Orthop Relat Res*; Mar 1987.

2157. Yan, H. W., Li, L., Wang, R. C., Yang, Y., Xie, Y., Tang, J., Shi, Z. Y. Clinical efficacies of coracoclavicular ligament reconstruction using suture anchor versus hook plate in the treatment of distal clavicle fracture. *Orthop Traumatol Surg Res*; Dec 2017.

2158. Bosworth, BM. Acromioclavicular separation: new method of repair. *Surg Gynecol Obste*; 1941.

2159. Dewar, F. P., Barrington, T. W. The Treatment of Chronic Acromio-Clavicular Dislocation. *J Bone Joint Surg Br*; Feb 1965.

2160. Norrell, H.,Jr., Llewellyn, R. C. Migration of a threaded steinmann pin from an acromioclavicular joint into the spinal canal. a case report. *J Bone Joint Surg Am*; Jul 1965.

2161. Weaver, J. K., Dunn, H. K. Treatment of acromioclavicular injuries, especially complete acromioclavicular separation. *J Bone Joint Surg Am*; Sep 1972.

2162. Ejeskar, A. Coracoclavicular wiring for acromioclavicular joint dislocation. A ten year follow-up study. *Acta Orthop Scand*; 1974.

2163. Katznelson, A., Nerubay, J., Oliver, S. Dynamic fixation of the avulsed clavicle. *J Trauma*; Oct 1976.

2164. Sethi, G. K., Scott, S. M. Subclavian artery laceration due to migration of a Hagie pin. *Surgery*; Nov 1976.

2165. Bargren, J. H., Erlanger, S., Dick, H. M. Biomechanics and comparison of two operative methods of treatment of complete acromioclavicular separation. *Clin Orthop Relat Res*; Jan-Feb 1978.

2166. Vainionpaa, S., Kirves, P., Laike, E. Acromioclavicular joint dislocation - surgical results in 36 patients. *Ann Chir Gynaecol*; 1981.

2167. Paavolainen, P., Bjorkenheim, J. M., Paukku, P., Slatis, P. Surgical treatment of acromioclavicular dislocation: a review of 39 patients. *Injury*; Mar 1983.

2168. Eskola, A., Vainionpaa, S., Patiala, H., Rokkanen, P. Outcome of operative treatment in fresh lateral clavicular fracture. *Ann Chir Gynaecol*; 1987.

2169. Ho, W. P., Chen, J. Y., Shih, C. H. The surgical treatment of complete acromioclavicular joint dislocation. *Orthop Rev*; Nov 1988.

2170. Ferris, B. D., Bhamra, M., Paton, D. F. Coracoid process transfer for acromioclavicular dislocations. A report of 20 cases. *Clin Orthop Relat Res*; May 1989.

2171. Jalovaara, P., Paivansalo, M., Myllyla, V., Niinimaki, T. Acute acromioclavicular dislocations treated by fixation of the joint and ligament repair or reconstruction. *Acta Orthop Belg*; 1991.

2172. Morrison, D. S., Lemos, M. J. Acromioclavicular separation. Reconstruction using synthetic loop augmentation. *Am J Sports Med*; Jan-Feb 1995.

2173. Sim, E., Schwarz, N., Hocker, K., Berzlanovich, A. Repair of complete acromioclavicular separations using the acromioclavicular-hook plate. *Clin Orthop Relat Res*; May 1995.

2174. Faraj, A. A., Ketzer, B. The use of a hook-plate in the management of acromioclavicular injuries. Report of ten cases. *Acta Orthop Belg*; Dec 2001.

2175. Jones, H. P., Lemos, M. J., Schepsis, A. A. Salvage of failed acromioclavicular joint reconstruction using autogenous semitendinosus tendon from the knee. Surgical technique and case report. *Am J Sports Med*; Mar-Apr 2001.

2176. Boldin, C., Fankhauser, F., Ratschek, M., Haller-Schober, E. M. Foreign-body reaction after reconstruction of complete acromioclavicular dislocation using PDS augmentation. *J Shoulder Elbow Surg*; Jan-Feb 2004.

2177. Stewart, A. M., Ahmad, C. S. Failure of acromioclavicular reconstruction using Gore-Tex graft due to aseptic foreign-body reaction and clavicle osteolysis: a case report. *J Shoulder Elbow Surg*; Sep-Oct 2004.

2178. Lafosse, L., Baier, G. P., Leuzinger, J. Arthroscopic treatment of acute and chronic acromioclavicular joint dislocation. *Arthroscopy*; Aug 2005.

2179. LaPrade, R. F., Hilger, B. Coracoclavicular ligament reconstruction using a semitendinosus graft for failed acromioclavicular separation surgery. *Arthroscopy*; Oct 2005.

2180. Yoo, J. C., Choi, N. H., Kim, S. Y., Lim, T. K. Distal clavicle tunnel widening after coracoclavicular ligament reconstruction with semitendinous tendon: a case report. *J Shoulder Elbow Surg*; Mar-Apr 2006.

2181. DePalma, AF. The role of the disks of the sternoclavicular and the acromioclavicular joints. *Clin Orthop*; 1959.

2182. Kristiansen, B. External fixation of proximal humerus fracture. Clinical and cadaver study of pinning technique. *Acta Orthop Scand*; Dec 1987.

2183. Kannus, P., Palvanen, M., Niemi, S., Parkkari, J., Jarvinen, M., Vuori, I. Increasing number and incidence of osteoporotic fractures of the proximal humerus in elderly people. *BMJ*; Oct 26 1996.

2184. Palvanen, M., Kannus, P., Niemi, S., Parkkari, J. Update in the epidemiology of proximal humeral fractures. *Clin Orthop Relat Res*; Jan 2006.

2185. Baron, JA, Barrett, JA, Karagas, MR. The epidemiology of peripheral fractures. *Bone*; 1996.

2186. Benger, U, Johnell, O, Redlund-Johnell, I. Changes in the incidence of fracture of the upper end of the humerus during a thrirty-year period. *Clin Orthop Relat Res*; 1988.

2187. Singer, B. R., McLauchlan, G. J., Robinson, C. M., Christie, J. Epidemiology of fractures in 15,000 adults: the influence of age and gender. *J Bone Joint Surg Br*; Mar 1998.

2188. Donaldson, L. J., Cook, A., Thomson, R. G. Incidence of fractures in a geographically defined population. *J Epidemiol Community Health*; Sep 1990.

2189. Court-Brown, C. M., Garg, A., McQueen, M. M. The epidemiology of proximal humeral fractures. *Acta Orthop Scand*; Aug 2001.

2190. Fink, H. A., Ensrud, K. E., Nelson, D. B., Kerani, R. P., Schreiner, P. J., Zhao, Y., Cummings, S. R., Nevitt, M. C. Disability after clinical fracture in postmenopausal women with low bone density: the fracture intervention trial (FIT). *Osteoporos Int*; Jan 2003.

2191. Lee, S. H., Dargent-Molina, P., Breart, G. Risk factors for fractures of the proximal humerus: results from the EPIDOS prospective study. *J Bone Miner Res*; May 2002.

2192. Nguyen, T. V., Center, J. R., Sambrook, P. N., Eisman, J. A. Risk factors for proximal humerus, forearm, and wrist fractures in elderly men and women: the Dubbo Osteoporosis Epidemiology Study. *Am J Epidemiol*; Mar 15 2001.

2193. Kelsey, J. L., Browner, W. S., Seeley, D. G., Nevitt, M. C., Cummings, S. R. Risk factors for fractures of the distal forearm and proximal humerus. The Study of Osteoporotic Fractures Research Group. *Am J Epidemiol*; Mar 1 1992.

2194. Lauritzen, J. B., Schwarz, P., McNair, P., Lund, B., Transbol, I. Radial and humeral fractures as predictors of subsequent hip, radial or humeral fractures in women, and their seasonal variation. *Osteoporos Int*; May 1993.

2195. Rose, S. H., Melton, L. J.,3rd, Morrey, B. F., Ilstrup, D. M., Riggs, B. L. Epidemiologic features of humeral fractures. *Clin Orthop Relat Res*; Aug 1982.

2196. Changulani, M., Jain, U. K., Keswani, T. Comparison of the use of the humerus intramedullary nail and dynamic compression plate for the management of diaphyseal fractures of the humerus. A randomised controlled study. *Int Orthop*; Jun 2007.

2197. Chapman, J. R., Henley, M. B., Agel, J., Benca, P. J. Randomized prospective study of humeral shaft fracture fixation: intramedullary nails versus plates. *J Orthop Trauma*; Mar-Apr 2000.

2198. McCormack, R. G., Brien, D., Buckley, R. E., McKee, M. D., Powell, J., Schemitsch, E. H. Fixation of fractures of the shaft of the humerus by dynamic compression plate or intramedullary nail. A prospective, randomised trial. *J Bone Joint Surg Br*; Apr 2000.

2199. United States Preventive Services Task Force (USPSTF), . Routine aspirin or nonsteroidal anti-inflammatory drugs for the primary prevention of colorectal cancer: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*; Mar 6 2007.

2200. Doetsch, A. M., Faber, J., Lynnerup, N., Watjen, I., Bliddal, H., Danneskiold-Samsoe, B. The effect of calcium and vitamin D3 supplementation on the healing of the proximal humerus fracture: a randomized placebo-controlled study. *Calcif Tissue Int*; Sep 2004.

2201. Shoback, D,Rosen,CJ,Black,DM,et al. Pharmacological management of osteoporosis in postmenopausal women: an Endocrine Society guideline update. *J Clin Endocrinol Metabolism*; 2020.

2202. Harris, ST,Blumentals,WA,Miller,PD. Ibandronate and the risk of non-vertebral and clinical fractures in women with postmenopausal osteoporosis: results of a meta-analysis of phase III studies. *Curr Med Res Opin*; 2008.

2203. Neer, C. S.,2nd. Displaced proximal humeral fractures. II. Treatment of three-part and four-part displacement. *J Bone Joint Surg Am*; Sep 1970.

2204. Rasmussen, S., Hvass, I., Dalsgaard, J., Christensen, B. S., Holstad, E. Displaced proximal humeral fractures: results of conservative treatment. *Injury*; 1992.

2205. Mora Guix, J. M., Pedros, J. S., Serrano, A. C. Updated classification system for proximal humeral fractures. *Clin Med Res*; Jun 2009.

2206. Fjalestad, T., Stromsoe, K., Blucher, J., Tennoe, B. Fractures in the proximal humerus: functional outcome and evaluation of 70 patients treated in hospital. *Arch Orthop Trauma Surg*; Jun 2005.

2207. Jakob, R. P., Miniaci, A., Anson, P. S., Jaberg, H., Osterwalder, A., Ganz, R. Four-part valgus impacted fractures of the proximal humerus. *J Bone Joint Surg Br*; Mar 1991.

2208. Lanting, B., MacDermid, J., Drosdowech, D., Faber, K. J. Proximal humeral fractures: a systematic review of treatment modalities. *J Shoulder Elbow Surg*; Jan-Feb 2008.

2209. Zyto, K., Ahrengart, L., Sperber, A., Tornkvist, H. Treatment of displaced proximal humeral fractures in elderly patients. *J Bone Joint Surg Br*; May 1997.

2210. Brunner, Felix M. D., Sommer, Christoph M. D., Bahrs, Christian M. D., Heuwinkel, Rainer M. D., Hafner, Christian M. D., Rillmann, Paavo M. D., Kohut, Georges M. D., Ekelund, Anders M. D. PhD, Muller, Mathias M. D., Audige, Laurent D. V. M. PhD, Babst, Reto M. D. Open reduction and internal fixation of proximal humerus fractures using a proximal humeral locked plate: a prospective multicenter analysis. *Journal of Orthopaedic Trauma*; 2009.

2211. Knight, R. A., Mayne, J. A. Comminuted fractures and fracture-dislocations involving the articular surface of the humeral head. *J Bone Joint Surg Am*; Dec 1957.

2212. Szyszkowitz, R., Seggl, W., Schleifer, P., Cundy, P. J. Proximal humeral fractures. Management techniques and expected results. *Clin Orthop Relat Res*; Jul 1993.

2213. Qian, Q. R., Wu, H. S., Zhou, W. J., Li, X. H., Wu, Y. L. Proximal humeral fractures treated with arthroplasty. *Chin J Traumatol*; Oct 2005.

2214. Jones, R. N., Wojeski, W., Bakke, J., Porter, C., Searles, M. Antibiotic prophylaxis of 1,036 patients undergoing elective surgical procedures. A prospective, randomized comparative trial of cefazolin, cefoxitin, and cefotaxime in a prepaid medical practice. *Am J Surg*; Apr 1987.

2215. Sturzenegger, M., Fornaro, E., Jakob, R. P. Results of surgical treatment of multifragmented fractures of the humeral head. *Arch Orthop Trauma Surg*; 1982.

2216. Imatani, R. J. Fractures of the scapula: a review of 53 fractures. *J Trauma*; Jun 1975.

2217. Rowe, C. R. Fractures of the Scapula. *Surg Clin North Am*; Dec 1963.

2218. Thompson, D. A., Flynn, T. C., Miller, P. W., Fischer, R. P. The significance of scapular fractures. *J Trauma*; Oct 1985.

2219. Ideberg, R., Grevsten, S., Larsson, S. Epidemiology of scapular fractures. Incidence and classification of 338 fractures. *Acta Orthop Scand*; Oct 1995.

2220. Guttentag, I. J., Rechtine, G. R. Fractures of the scapula. A review of the literature. *Orthop Rev*; Feb 1988.

2221. McGahan, J. P., Rab, G. T., Dublin, A. Fractures of the scapula. *J Trauma*; Oct 1980.

2222. Pasapula, C., Mandalia, V., Aslam, N. The floating shoulder. *Acta Orthop Belg*; Oct 2004.

2223. McGinnis, M., Denton, J. R. Fractures of the scapula: a retrospective study of 40 fractured scapulae. *J Trauma*; Nov 1989.

2224. Goss, T. P. The scapula: coracoid, acromial, and avulsion fractures. *Am J Orthop*; Feb 1996.

2225. Wong-Pack, W. K., Bobechko, P. E., Becker, E. J. Fractured coracoid with anterior shoulder dislocation. *J Can Assoc Radiol*; Dec 1980.

2226. Zilberman, Z., Rejovitzky, R. Fracture of the coracoid process of the scapula. *Injury*; Nov 1981.

2227. Lantry, J. M., Roberts, C. S., Giannoudis, P. V. Operative treatment of scapular fractures: a systematic review. *Injury*; Mar 2008.

2228. Lapner, P. C., Uhthoff, H. K., Papp, S. Scapula fractures. *Orthop Clin North Am*; Oct 2008.

2229. Benchetrit, E., Friedman, B. Fracture of the coracoid process associated with subglenoid dislocation of the shoulder. A case report. *J Bone Joint Surg Am*; Mar 1979.

2230. Heyse-Moore, G. H., Stoker, D. J. Avulsion fractures of the scapula. *Skeletal Radiol*; 1982.

2231. Izadpanah, M. Osteosynthese in scapula fractures (author's transl). *Arch Orthop Unfallchir*; Oct 27 1975.

2232. Li, W. J., Liang, X. J., Cheng, D. G., Lu, X. Y., Zhang, L., Li, H. H. Surgery for scapular neck displaced fracture. *Zhonghua Yi Xue Za Zhi*; Jun 20 2006.

2233. Esenkaya, I. Surgical treatment of scapular fractures. *Acta Orthop Traumatol Turc*; 2003.

2234. Oh, W., Jeon, I. H., Kyung, S., Park, C., Kim, T., Ihn, C. The treatment of double disruption of the superior shoulder suspensory complex. *Int Orthop*; 2002.

2235. Schandelmaier, P., Blauth, M., Schneider, C., Krettek, C. Fractures of the glenoid treated by operation. A 5- to 23-year follow-up of 22 cases. *J Bone Joint Surg Br*; Mar 2002.

2236. Vecsei, V., Dann, K. Surgical management of shoulderblade fractures. *Aktuelle Traumatol*; Dec 1990.

2237. Ecke, H., Hofmann, D., Walther, H. Fractures of the glenoid surface of the scapula. *Unfallchirurgie*; Feb 1987.

2238. Kavanagh, B. F., Bradway, J. K., Cofield, R. H. Open reduction and internal fixation of displaced intra-articular fractures of the glenoid fossa. *J Bone Joint Surg Am*; Apr 1993.

2239. Zlowodzki, M., Bhandari, M., Zelle, B. A., Kregor, P. J., Cole, P. A. Treatment of scapula fractures: systematic review of 520 fractures in 22 case series. *J Orthop Trauma*; Mar 2006.

2240. Bauer, G., Fleischmann, W., Dussler, E. Displaced scapular fractures: indication and long-term results of open reduction and internal fixation. *Arch Orthop Trauma Surg*; 1995.

2241. Leung, K. S., Lam, T. P. Open reduction and internal fixation of ipsilateral fractures of the scapular neck and clavicle. *J Bone Joint Surg Am*; Jul 1993.

2242. Grassi, F. A., Tajana, M. S., D'Angelo, F. Management of midclavicular fractures: comparison between nonoperative treatment and open intramedullary fixation in 80 patients. *J Trauma*; Jun 2001.

2243. Lenza, M., Belloti, J. C., Andriolo, R. B., Gomes Dos Santos, J. B., Faloppa, F. Conservative interventions for treating middle third clavicle fractures in adolescents and adults. *Cochrane Database Syst Rev*; 2009.

2244. Zenni, E. J.,Jr., Krieg, J. K., Rosen, M. J. Open reduction and internal fixation of clavicular fractures. *J Bone Joint Surg Am*; Jan 1981.

2245. Shetty, S. K., Chandran, R., Ballal, A., Mathias, L. J., Hegde, A., Shetty, A. To Operate or not to Operate the Mid-Shaft Fractures of the Clavicle: A Comparative Study of Functional Outcomes of the Two Methods of Management. *J Clin Diagn Res*; Jan 2017.

2246. Shen, W. J., Liu, T. J., Shen, Y. S. Plate fixation of fresh displaced midshaft clavicle fractures. *Injury*; Sep 1999.

2247. Lee, Y. S., Huang, H. L., Lo, T. Y., Hsieh, Y. F., Huang, C. R. Surgical treatment of midclavicular fractures: a prospective comparison of Knowles pinning and plate fixation. *Int Orthop*; Aug 2008.

2248. Pai, H. T., Lee, Y. S., Cheng, C. Y. Surgical treatment of midclavicular fractures in the elderly: a comparison of locking and nonlocking plates. *Orthopedics*; Apr 2009.

2249. Kloen, P., Werner, C. M., Stufkens, S. A., Helfet, D. L. Anteroinferior plating of midshaft clavicle nonunions and fractures. *Oper Orthop Traumatol*; Jun 2009.

2250. Lee, Y. S., Lin, C. C., Huang, C. R., Chen, C. N., Liao, W. Y. Operative treatment of midclavicular fractures in 62 elderly patients: knowles pin versus plate. *Orthopedics*; Nov 2007.

2251. Potter, J. M., Jones, C., Wild, L. M., Schemitsch, E. H., McKee, M. D. Does delay matter? The restoration of objectively measured shoulder strength and patient-oriented outcome after immediate fixation versus delayed reconstruction of displaced midshaft fractures of the clavicle. *J Shoulder Elbow Surg*; Sep-Oct 2007.

2252. Duarte, L. R. The stimulation of bone growth by ultrasound. *Arch Orthop Trauma Surg*; 1983.

2253. Dyson, M., Brookes, M. Stimulation of bone repair by ultrasound. *Ultrasound Med Biol*; 1983.

2254. Kristiansen, T. K., Ryaby, J. P., McCabe, J., Frey, J. J., Roe, L. R. Accelerated healing of distal radial fractures with the use of specific, low-intensity ultrasound. A multicenter, prospective, randomized, double-blind, placebo-controlled study. *J Bone Joint Surg Am*; Jul 1997.

2255. Mayr, E., Rudzki, M. M., Rudzki, M., Borchardt, B., Hausser, H., Ruter, A. Does low intensity, pulsed ultrasound speed healing of scaphoid fractures? *Handchir Mikrochir Plast Chir*; Mar 2000.

2256. Rue, J. P., Armstrong, D. W.,3rd, Frassica, F. J., Deafenbaugh, M., Wilckens, J. H. The effect of pulsed ultrasound in the treatment of tibial stress fractures. *Orthopedics*; Nov 2004.

2257. Schortinghuis, J., Ruben, J. L., Raghoebar, G. M., Stegenga, B., de Bont, L. G. Does ultrasound stimulate osteoconduction? A placebo-controlled single-blind study using collagen membranes in the rat mandible. *Int J Oral Maxillofac Implants*; Mar-Apr 2005.

2258. El-Mowafi, H., Mohsen, M. The effect of low-intensity pulsed ultrasound on callus maturation in tibial distraction osteogenesis. *Int Orthop*; Apr 2005.

2259. Tsumaki, N., Kakiuchi, M., Sasaki, J., Ochi, T., Yoshikawa, H. Low-intensity pulsed ultrasound accelerates maturation of callus in patients treated with opening-wedge high tibial osteotomy by hemicallotasis. *J Bone Joint Surg Am*; Nov 2004.

2260. Ricardo, M. The effect of ultrasound on the healing of muscle-pediculated bone graft in scaphoid non-union. *Int Orthop*; Apr 2006.

2261. Handolin, L., Kiljunen, V., Arnala, I., Pajarinen, J., Partio, E. K., Rokkanen, P. The effect of low intensity ultrasound and bioabsorbable self-reinforced poly-L-lactide screw fixation on bone in lateral malleolar fractures. *Arch Orthop Trauma Surg*; Jun 2005.

2262. Emami, A., Petren-Mallmin, M., Larsson, S. No effect of low-intensity ultrasound on healing time of intramedullary fixed tibial fractures. *J Orthop Trauma*; May 1999.

2263. Allieu, Y., Cenac, P. Neurotization via the spinal accessory nerve in complete paralysis due to multiple avulsion injuries of the brachial plexus. *Clin Orthop Relat Res*; Dec 1988.

2264. Blaauw, G., Muhlig, R. S., Vredeveld, J. W. Management of brachial plexus injuries. *Adv Tech Stand Neurosurg*; 2008.

2265. Wittenberg, K. H., Adkins, M. C. MR imaging of nontraumatic brachial plexopathies: frequency and spectrum of findings. *Radiographics*; Jul-Aug 2000.

2266. Miller, J. D., Pruitt, S., McDonald, T. J. Acute brachial plexus neuritis: an uncommon cause of shoulder pain. *Am Fam Physician*; Nov 1 2000.

2267. Castagno, A. A., Shuman, W. P. MR imaging in clinically suspected brachial plexus tumor. *AJR Am J Roentgenol*; Dec 1987.

2268. Dart, L. H.,Jr., MacCarty, C. S., Love, J. G., Dockerty, M. B. Neoplasms of the brachial plexus. *Minn Med*; Sep 1970.

2269. McLoud, T. C., Filion, R. B., Edelman, R. R., Shepard, J. A. MR imaging of superior sulcus carcinoma. *J Comput Assist Tomogr*; Mar-Apr 1989.

2270. Levin, K. H., Wilbourn, A. J., Maggiano, H. J. Cervical rib and median sternotomy-related brachial plexopathies: a reassessment. *Neurology*; May 1998.

2271. Bowen, B. C., Verma, A., Brandon, A. H., Fiedler, J. A. Radiation-induced brachial plexopathy: MR and clinical findings. *AJNR Am J Neuroradiol*; Nov-Dec 1996.

2272. Hems, T. E., Birch, R., Carlstedt, T. The role of magnetic resonance imaging in the management of traction injuries to the adult brachial plexus. *J Hand Surg Br*; 1999.

2273. Doi, K., Otsuka, K., Okamoto, Y., Fujii, H., Hattori, Y., Baliarsing, A. S. Cervical nerve root avulsion in brachial plexus injuries: magnetic resonance imaging classification and comparison with myelography and computerized tomography myelography. *J Neurosurg*; 2002.

2274. Brunelli, G., Brunelli, F. Surgical treatment of actinic brachial plexus lesions: free microvascular transfer of the greater omentum. *J Reconstr Microsurg*; Jan 1985.

2275. Doi, K., Kuwata, N., Muramatsu, K., Hottori, Y., Kawai, S. Double muscle transfer for upper extremity reconstruction following complete avulsion of the brachial plexus. *Hand Clin*; Nov 1999.

2276. Doi, K., Muramatsu, K., Hattori, Y., Otsuka, K., Tan, S. H., Nanda, V., Watanabe, M. Restoration of prehension with the double free muscle technique following complete avulsion of the brachial plexus. Indications and long-term results. *J Bone Joint Surg Am*; May 2000.

2277. Narakas, A. O. The treatment of brachial plexus injuries. *Int Orthop*; 1985.

2278. Sureka, J., Cherian, R. A., Alexander, M., Thomas, B. P. MRI of brachial plexopathies. *Clin Radiol*; Feb 2009.

2279. Bowen, B. C., Pattany, P. M., Saraf-Lavi, E., Maravilla, K. R. The brachial plexus: normal anatomy, pathology, and MR imaging. *Neuroimaging Clin N Am*; Feb 2004.

2280. Rapoport, S., Blair, D. N., McCarthy, S. M., Desser, T. S., Hammers, L. W., Sostman, H. D. Brachial plexus: correlation of MR imaging with CT and pathologic findings. *Radiology*; Apr 1988.

2281. Yoshikawa, T., Hayashi, N., Yamamoto, S., Tajiri, Y., Yoshioka, N., Masumoto, T., Mori, H., Abe, O., Aoki, S., Ohtomo, K. Brachial plexus injury: clinical manifestations, conventional imaging findings, and the latest imaging techniques. *Radiographics*; Oct 2006.

2282. Lucas, N., Macaskill, P., Irwig, L., Moran, R., Bogduk, N. Reliability of physical examination for diagnosis of myofascial trigger points: a systematic review of the literature. *Clin J Pain*; Jan 2009.

2283. Gerwin, R. D. A review of myofascial pain and fibromyalgia--factors that promote their persistence. *Acupunct Med*; Sep 2005.

2284. Myburgh, C., Larsen, A. H., Hartvigsen, J. A systematic, critical review of manual palpation for identifying myofascial trigger points: evidence and clinical significance. *Arch Phys Med Rehabil*; Jun 2008.

2285. Nice, D. A., Riddle, D. L., Lamb, R. L., Mayhew, T. P., Rucker, K. Intertester reliability of judgments of the presence of trigger points in patients with low back pain. *Arch Phys Med Rehabil*; Oct 1992.

2286. Levoska, S. Manual palpation and pain threshold in female office employees with and without neck-shoulder symptoms. *Clin J Pain*; Dec 1993.

2287. Njoo, K. H., Van der Does, E. The occurrence and inter-rater reliability of myofascial trigger points in the quadratus lumborum and gluteus medius: a prospective study in non-specific low back pain patients and controls in general practice. *Pain*; Sep 1994.

2288. Gerwin, R. D., Shannon, S., Hong, C. Z., Hubbard, D., Gevirtz, R. Interrater reliability in myofascial trigger point examination. *Pain*; Jan 1997.

2289. Hwang, M., Kang, Y. K., Kim, D. H. Referred pain pattern of the pronator quadratus muscle. *Pain*; Aug 2005.

2290. Farasyn, A. Referred muscle pain is primarily peripheral in origin: the “barrier-dam” theory. *Med Hypotheses*; 2007.

2291. Simons, D. G. New views of myofascial trigger points: etiology and diagnosis. *Arch Phys Med Rehabil*; Jan 2008.

2292. Wheeler, A. H. Myofascial pain disorders: theory to therapy. *Drugs*; 2004.

2293. Pearce, J. M. Myofascial pain, fibromyalgia or fibrositis? *Eur Neurol*; 2004.

2294. Fleckenstein, J., Zaps, D., Ruger, L. J., Lehmeyer, L., Freiberg, F., Lang, P. M., Irnich, D. Discrepancy between prevalence and perceived effectiveness of treatment methods in myofascial pain syndrome: results of a cross-sectional, nationwide survey. *BMC Musculoskelet Disord*; 2010.

2295. Coster, L., Kendall, S., Gerdle, B., Henriksson, C., Henriksson, K. G., Bengtsson, A. Chronic widespread musculoskeletal pain - a comparison of those who meet criteria for fibromyalgia and those who do not. *Eur J Pain*; Jul 2008.

2296. Friedrich, M., Hahne, J., Wepner, F. A controlled examination of medical and psychosocial factors associated with low back pain in combination with widespread musculoskeletal pain. *Phys Ther*; Aug 2009.

2297. Giannakopoulos, N. N., Keller, L., Rammelsberg, P., Kronmuller, K. T., Schmitter, M. Anxiety and depression in patients with chronic temporomandibular pain and in controls. *J Dent*; May 2010.

2298. Mongini, F., Ciccone, G., Ceccarelli, M., Baldi, I., Ferrero, L. Muscle tenderness in different types of facial pain and its relation to anxiety and depression: A cross-sectional study on 649 patients. *Pain*; Sep 2007.

2299. Altindag, O., Gur, A., Altindag, A. The relationship between clinical parameters and depression level in patients with myofascial pain syndrome. *Pain Med*; Mar 2008.

2300. Wolfe, F., Smythe, H. A., Yunus, M. B., Bennett, R. M., Bombardier, C., Goldenberg, D. L., Tugwell, P., Campbell, S. M., Abeles, M., Clark, P., et al., . The American College of Rheumatology 1990 Criteria for the Classification of Fibromyalgia. Report of the Multicenter Criteria Committee. *Arthritis Rheum*; Feb 1990.

2301. Anderson, D. M., Sinclair, P. M., McBride, K. M. A clinical evaluation of temporomandibular joint disk plication surgery. *Am J Orthod Dentofacial Orthop*; Aug 1991.

2302. Rubinoff, M. S., Gross, A., McCall, W. D.,Jr. Conventional and nonoccluding splint therapy compared for patients with myofascial pain dysfunction syndrome. *Gen Dent*; Nov-Dec 1987.

2303. Raustia, A. M. Diagnosis and treatment of temporomandibular joint dysfunction. Advantages of computed tomography diagnosis. Stomatognathic treatment and acupuncture--a randomized trial. *Proc Finn Dent Soc*; 1986.

2304. Magnusson, T., Syren, M. Therapeutic jaw exercises and interocclusal appliance therapy. A comparison between two common treatments of temporomandibular disorders. *Swed Dent J*; 1999.

2305. De Laat, A, Stappaerts, K, Papy, S. Counseling and physical therapy as treatment for myofascial pain of the masticatory system. *J Orofac Pain*; 2003.

2306. Yap, E. C. Myofascial pain--an overview. *Ann Acad Med Singapore*; Jan 2007.

2307. Han, SC, Harrison, P. Myofascial pain syndrome and trigger-point management. *Reg Anesth*; 1997.

2308. . Acute and Chronic Low Back Pain. *Effective Health Care*; 2000.

2309. Qerama, E., Fuglsang-Frederiksen, A., Kasch, H., Bach, F. W., Jensen, T. S. A double-blind, controlled study of botulinum toxin A in chronic myofascial pain. *Neurology*; Jul 25 2006.

2310. Richards, B. A., Jensen, . A double-blind, controlled study of botulinum toxin A in chronic myofascial pain. *Neurology*; Mar 20 2007.

2311. Ferrante, F. M., Bearn, L., Rothrock, R., King, L. Evidence against trigger point injection technique for the treatment of cervicothoracic myofascial pain with botulinum toxin type A. *Anesthesiology*; Aug 2005.

2312. Lew, M. F., Adornato, B. T., Duane, D. D., Dykstra, D. D., Factor, S. A., Massey, J. M., Brin, M. F., Jankovic, J., Rodnitzky, R. L., Singer, C., Swenson, M. R., Tarsy, D., Murray, J. J., Koller, M., Wallace, J. D. Botulinum toxin type B: a double-blind, placebo-controlled, safety and efficacy study in cervical dystonia. *Neurology*; Sep 1997.

2313. Brashear, A., Ambrosius, W. T., Eckert, G. J., Siemers, E. R. Comparison of treatment of tardive dystonia and idiopathic cervical dystonia with botulinum toxin type A. *Mov Disord*; Jan 1998.

2314. Benecke, R., Jost, W. H., Kanovsky, P., Ruzicka, E., Comes, G., Grafe, S. A new botulinum toxin type A free of complexing proteins for treatment of cervical dystonia. *Neurology*; Jun 14 2005.

2315. Brans, J. W., Lindeboom, R., Snoek, J. W., Zwarts, M. J., van Weerden, T. W., Brunt, E. R., van Hilten, J. J., van der Kamp, W., Prins, M. H., Speelman, J. D. Botulinum toxin versus trihexyphenidyl in cervical dystonia: a prospective, randomized, double-blind controlled trial. *Neurology*; Apr 1996.

2316. Lew, M. F., Brashear, A., Factor, S. The safety and efficacy of botulinum toxin type B in the treatment of patients with cervical dystonia: summary of three controlled clinical trials. *Neurology*; 2000.

2317. Brin, M. F., Lew, M. F., Adler, C. H., Comella, C. L., Factor, S. A., Jankovic, J., O'Brien, C., Murray, J. J., Wallace, J. D., Willmer-Hulme, A., Koller, M. Safety and efficacy of NeuroBloc (botulinum toxin type B) in type A-resistant cervical dystonia. *Neurology*; Oct 22 1999.

2318. Tassorelli, C., Mancini, F., Balloni, L., Pacchetti, C., Sandrini, G., Nappi, G., Martignoni, E. Botulinum toxin and neuromotor rehabilitation: An integrated approach to idiopathic cervical dystonia. *Mov Disord*; Dec 2006.

2319. Poewe, W., Deuschl, G., Nebe, A., Feifel, E., Wissel, J., Benecke, R., Kessler, K. R., Ceballos-Baumann, A. O., Ohly, A., Oertel, W., Kunig, G. What is the optimal dose of botulinum toxin A in the treatment of cervical dystonia? Results of a double blind, placebo controlled, dose ranging study using Dysport. German Dystonia Study Group. *J Neurol Neurosurg Psychiatry*; Jan 1998.

2320. Pappert, E. J., Germanson, T. Botulinum toxin type B vs. type A in toxin-naive patients with cervical dystonia: Randomized, double-blind, noninferiority trial. *Mov Disord*; Mar 15 2008.

2321. Ostergaard, L., Fuglsang-Frederiksen, A., Werdelin, L., Sjo, O., Winkel, H. Quantitative EMG in botulinum toxin treatment of cervical dystonia. A double-blind, placebo-controlled study. *Electroencephalogr Clin Neurophysiol*; Dec 1994.

2322. Odergren, T., Hjaltason, H., Kaakkola, S., Solders, G., Hanko, J., Fehling, C., Marttila, R. J., Lundh, H., Gedin, S., Westergren, I., Richardson, A., Dott, C., Cohen, H. A double blind, randomised, parallel group study to investigate the dose equivalence of Dysport and Botox in the treatment of cervical dystonia. *J Neurol Neurosurg Psychiatry*; Jan 1998.

2323. Laubis-Herrmann, U., Fries, K., Topka, H. Low-dose botulinum toxin-a treatment of cervical dystonia - a double-blind, randomized pilot study. *Eur Neurol*; 2002.

2324. Ranoux, D., Attal, N., Morain, F., Bouhassira, D. Botulinum toxin type A induces direct analgesic effects in chronic neuropathic pain. *Ann Neurol*; Sep 2008.

2325. Naumann, M., Yakovleff, A., Durif, F. A randomized, double-masked, crossover comparison of the efficacy and safety of botulinum toxin type A produced from the original bulk toxin source and current bulk toxin source for the treatment of cervical dystonia. *J Neurol*; Jan 2002.

2326. Lu, C. S., Chen, R. S., Tsai, C. H. Double-blind, placebo-controlled study of botulinum toxin injections in the treatment of cervical dystonia. *J Formos Med Assoc*; Apr 1995.

2327. Comella, C. L., Jankovic, J., Shannon, K. M., Tsui, J., Swenson, M., Leurgans, S., Fan, W. Comparison of botulinum toxin serotypes A and B for the treatment of cervical dystonia. *Neurology*; Nov 8 2005.

2328. Truong, D., Duane, D. D., Jankovic, J., Singer, C., Seeberger, L. C., Comella, C. L., Lew, M. F., Rodnitzky, R. L., Danisi, F. O., Sutton, J. P., Charles, P. D., Hauser, R. A., Sheean, G. L. Efficacy and safety of botulinum type A toxin (Dysport) in cervical dystonia: results of the first US randomized, double-blind, placebo-controlled study. *Mov Disord*; Jul 2005.

2329. Tsui, J. K., Eisen, A., Stoessl, A. J., Calne, S., Calne, D. B. Double-blind study of botulinum toxin in spasmodic torticollis. *Lancet*; Aug 2 1986.

2330. Blackie, J. D., Lees, A. J. Botulinum toxin treatment in spasmodic torticollis. *J Neurol Neurosurg Psychiatry*; Aug 1990.

2331. Lorentz, I. T., Subramaniam, S. S., Yiannikas, C. Treatment of idiopathic spasmodic torticollis with botulinum toxin A: a double-blind study on twenty-three patients. *Mov Disord*; 1991.

2332. Moore, A. P., Blumhardt, L. D. A double blind trial of botulinum toxin "A" in torticollis, with one year follow up. *J Neurol Neurosurg Psychiatry*; Sep 1991.

2333. Koller, W., Vetere-Overfield, B., Gray, C., Dubinsky, R. Failure of fixed-dose, fixed muscle injection of botulinum toxin in torticollis. *Clin Neuropharmacol*; Aug 1990.

2334. Greene, P., Kang, U., Fahn, S., Brin, M., Moskowitz, C., Flaster, E. Double-blind, placebo-controlled trial of botulinum toxin injections for the treatment of spasmodic torticollis. *Neurology*; Aug 1990.

2335. Gelb, D. J., Lowenstein, D. H., Aminoff, M. J. Controlled trial of botulinum toxin injections in the treatment of spasmodic torticollis. *Neurology*; Jan 1989.

2336. Evers, S., Vollmer-Haase, J., Schwaag, S., Rahmann, A., Husstedt, I. W., Frese, A. Botulinum toxin A in the prophylactic treatment of migraine--a randomized, double-blind, placebo-controlled study. *Cephalalgia*; Oct 2004.

2337. Charles, P. D. Botulinum neurotoxin serotype A: a clinical update on non-cosmetic uses. *Am J Health Syst Pharm*; Nov 15 2004.

2338. Wittekindt, C., Liu, W. C., Preuss, S. F., Guntinas-Lichius, O. Botulinum toxin A for neuropathic pain after neck dissection: a dose-finding study. *Laryngoscope*; Jul 2006.

2339. Naumann, M., Lowe, N. J. Botulinum toxin type A in treatment of bilateral primary axillary hyperhidrosis: randomised, parallel group, double blind, placebo controlled trial. *BMJ*; Sep 15 2001.

2340. Porta, M., Maggioni, G. Botulinum toxin (BoNT) and back pain. *J Neurol*; Feb 2004.

2341. De Andres, J., Cerda-Olmedo, G., Valia, J. C., Monsalve, V., Lopez, Alarcon, Minguez, A. Use of botulinum toxin in the treatment of chronic myofascial pain. *Clin J Pain*; Jul-Aug 2003.