American College of Occupational and Environmental Medicine

Elbow Disorders

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Contributors to the Elbow Disorders Chapter

Editor-in-Chief:
Kurt T. Hegmann, MD, MPH, FACOEM, FACP

Evidence-based Practice Elbow Panel Chair:
Harold E. Hoffman, MD, FACOEM, FRCPC

Evidence-based Practice Elbow Panel Members:
Roger M. Belcourt, MD, MPH, FACOEM
Kevin Byrne, MD, MPH, FACOEM
Lee Glass, MD, JD
J. Mark Melhorn, MD, FAAOS, FACOEM, FAADEP, FACS, FASSH, FAAHS
Jack Richman, MD, CCBOM, FACOEM, FAADEP, CIME
Phillip Zinni, III, DO, FAOASM

Methodology Committee Consultant:
Kurt T. Hegmann, MD, MPH, FACOEM, FACP

Managing Editors:
Production: Marianne Dreger, MA
Research: Julie A. Ording, MPH
Editorial Assistant: Debra M. Paddack

Research Conducted By:
Kurt T. Hegmann, MD, MPH, FACOEM, FACP
Matthew S. Thiese, PhD, MSPH
Ulrike Ott, MSPH
Kylee Tokita
Jessica Melendez
Deborah Gwenevere Passey, BS
Atim Cecelia Effiong, BS
Riann Bree Robbins, BS
William Gilbert Caughey, BS
Holly Uphold, BS

Specialty Society and Society Representative Listing:
ACOEM acknowledges the following organizations and their representatives who served as reviewers of the Elbow Disorders chapter. Their contributions are greatly appreciated. By listing the following individuals or organizations, it does not infer that these individuals or organizations support or endorse the elbow treatment guidelines developed by ACOEM.

The American Occupational Therapy Association, Inc.
Debbie Amini, EdD, OTR/L, CHT

Other External Reviewers:
Robert M. Szabo, MD, MPH

Table of Contents

Impact

Upper-extremity musculoskeletal disorders (MSDs) continue to account for a significant number of work-related illnesses and disabilities in the United States (U.S.). According to the Bureau of Labor Statistics, non-traumatic MSDs make up 65% of all occupational illnesses in the U.S.(1) Work-related elbow disorders are among the most common causes of reported occupational injuries and workers' compensation claims. These disorders are broadly and most accurately classified as MSDs.(2) In 2008, MSDs accounted for 29% of all workplace injuries requiring time away from work, compared to 30% of total days-away-from-work cases in 2006.(3) There were a total of 335,390 MSDs in 2007 requiring a median of 9 days away from work, two more days than the median for all days-away-from-work cases. This is a decline of 21,770 cases (6 percent) from 2006, and an 11 percent decline from 2005.(3)

Upper extremity MSDs, including elbow disorders, now account for at least 4% of all state workers' compensation claims, an increase from 1% seen a decade ago.(4-6) Of these, the State of Washington has reported that elbow disorders accounted for the third highest incidence rate with 29.7 injuries per 10,000 full-time employees.(7)

Overview of Management of Elbow Disorders

The following are the elbow disorders discussed in this chapter. Other prominent disorders, which include cervical radiculopathy and cervical and upper thoracic spinal stenosis (see Cervical and Thoracic Spinal Disorders chapter for extensive discussions), are not reviewed in this guideline in detail, but should be considered in the differential diagnosis of elbow pain and symptoms. Additional diagnostic considerations include hand/forearm disorders (see Hand, Wrist, and Forearm Disorders chapter, and Appendix 2, Fibromyalgia, in the Chronic Pain chapter); atherosclerotic abnormalities such as aneurysms, avulsion fractures, mononeuritis, benign tumors or cancer, crystal arthropathies (e.g., gout, pseudogout, hydroxyapatite); infections including septic arthritis, Lyme disease, reactive arthritis (formerly Reiters) or hepatitis B and C; and inflammatory or "collagen vascular" disorders such as rheumatoid arthritis, systemic lupus erythematosus, ankylosing spondylitis, dermatomyositis, and polymyalgia rheumatica.

Avascular Necrosis

See Osteonecrosis [Avascular Necrosis (AVN)].

Olecranon Bursitis

Bursae are sacks with a small amount of fluid that are usually located between structures that move and provide a cushion to reduce friction between the two moving body parts (e.g., between muscle and bone or between bone and overlying skin). Bursitis occurs when the bursae become inflamed and irritated. Olecranon bursitis is a common condition involving an irritated bursa between the olecranon process and overlying dermis. Causal mechanisms are somewhat unclear, but thought to include direct trauma over the olecranon such as bumping or falling on the elbow or leaning on the olecranon, particularly if this is unaccustomed practice. Treatment of olecranon bursitis has most commonly included avoidance of inciting events, non-steroidal anti-inflammatory drugs (NSAIDs), drainage/aspiration, a glucocorticosteroid injection, or surgery. Surgical drainage and antibiotics are required if the bursa becomes infected.

Biceps (and Triceps) Strains and Tears

A strain consists of a partial or complete disruption of a myotendinous junction. A biceps strain involves one or both tendons of the biceps brachii at the elbow. Bicipital tendinosis involves the long head of the biceps at the shoulder and is a more common condition (see ACOEM Shoulder Disorders Guideline); it is sometimes also referred to as biceps strain.

High-force activities generally cause biceps strains and tears, particularly when unaccustomed activities are involved. Prior strains presumably increase the probability of a future strain or tear. A complete muscular tear of the biceps may occur. Strains are treated by removal from high-force activities, and NSAIDs and therapy are used for more severely affected cases. Severe or complete biceps tears are usually treated surgically. Triceps tendon strains and tears are comparable to the biceps strains although less common. The triceps insertion on the olecranon is involved and treatment is similar to that recommended for biceps strains.

Cervical Radiculopathy and Cervical Stenosis

Cervical radiculopathy and stenosis are two common disorders that may present as elbow pain. Thus, they constitute prominent disorders in the differential diagnosis of elbow pain (see Cervical and Thoracic Spine Disorders chapter).

Contusions

Contusions result from blunt force trauma that ruptures blood vessels, producing bruises (ecchymoses). Common occupational causes include falls, motor vehicle accidents, and being struck by objects. These are generally self-limited conditions absent underlying structural damage. Treatment usually consists of ice, acetaminophen, NSAIDs, and relative rest.

Osteoarthrosis incl. Degenerative Joint Disease (Osteoarthritis and Degenerative Arthritis)

Elbow degenerative joint disease (DJD) is most commonly caused by osteoarthrosis (OA) and is relatively uncommon. While osteoarthritis is the more common name for this entity, osteoarthrosis is more technically precise as there is no classic inflammation. Other types of arthritic disorders that cause DJD include inflammatory autoimmune disorders (e.g., rheumatoid arthritis, systemic lupus erythematosus, psoriasis) and crystal diseases (e.g., gout, pseudogout, apatites). As these latter disorders are non-occupational, they are not included in this discussion. The x-ray appearance in each disorder may be indistinguishable, although at times there are radiologic characteristics that may suggest a specific diagnosis. Thus, a technically correct interpretation of an x-ray may include DJD, but not OA. There is a predisposition for patients who already have OA in one or two joints to develop OA in other joint groups. Several genetic factors have been identified.(8) Occupational factors related to elbow arthrosis are poorly understood and quality occupational epidemiological studies are lacking. Unilateral cases arising in a joint that sustained a prior fracture is often considered to be work-related. OA is generally treated with acetaminophen, NSAIDs, topical NSAIDs, heat, ice, counterirritants (e.g., capsaicin), education, avoidance of aggravating activities, exercises, injections (glucocorticosteroid and viscosupplementation), and surgical joint replacement.

Osteonecrosis [Avascular Necrosis (AVN)]

Osteonecrosis involves impairment of the blood supply to the bone and may evolve to subsequent degeneration and ultimately collapse of the bone. It is particularly likely to occur in areas of tenuous blood supply that lacks collateral blood flow – thus most prominently affecting the femoral and humeral heads. The elbow is rarely affected. The most prominent occupational risk factor is barotraumas ("the bends"), which may occur both in diving, as well as working in compressed air environments (e.g., tunneling projects through unstable sediments requiring compressed air to maintain the workspace). Significant, discrete trauma is thought to be a risk factor. However, the impact of non-traumatic job physical factors is controversial. Treatment is primarily based on reducing the implicated risk factor (e.g., alcohol, diabetes). A surgical coring procedure (vascularized and unvascularized bone grafting and osteotomy) are sometimes utilized. Severe cases may require arthroplasty.

Elbow Dislocation

Most elbow dislocations occur due to violent or high-speed collisions, falls, or are congenital due to joint malformation or excessive laxity. The mechanism of injury determines whether the condition is work-related. X-rays and relocation, which may call for anesthesia, are required.

Elbow Fracture

Elbow fractures include both frank and stress fractures. All fractures involve an application of force that is beyond the bone strength. Occupational fractures most commonly result from falls and motor vehicle accidents. Non-displaced radial head fractures are usually treated with slings and have excellent prognoses. Other fractures may require surgical fixation, casting, and/or cast bracing. Stress fractures are caused by repeated applications of unaccustomed force over hours to days. Pain is frequently worse at night; these are usually treated with elimination of the offending exposure and observation.

Epicondylalgia (Epicondylitis)

Epicondylalgia is a painful disorder of either the lateral elbow (lateral epicondylitis or tennis elbow) or medial elbow (medial epicondylitis or golfer's elbow), that most commonly has a gradual onset. But the pain may also occur acutely, such as from striking the elbow on a hard object. Underlying chronic degenerative conditions have been widely described in pathological studies.(9-11) Treatment most commonly involves NSAIDs, ice or heat, and glucocorticosteroid injections. Physical or occupational therapy including exercises is often prescribed. Surgical release is performed in cases that respond insufficiently to other treatments.

Pronator Syndrome

Pronator syndrome involves entrapment of the median nerve as it traverses the pronator muscle in the proximal forearm. The most common causes are fibrotic/fascial bands[i] generally within the muscle or muscle hypertrophy. Symptoms include paresthesias in the median nerve distribution (typically digits 1-3 and radial half of the 4th digit). Pain may be present. Nerve conduction studies are normal at the wrist, but abnormal proximally, as demonstrated by inching technique and/or segmental analysis. Patients are commonly treated for presumptive CTS. Treatment failure should suggest the possibility of pronator syndrome. Activity modification and splinting is the initial approach. Surgical release may be necessary in refractory cases.

Radial Neuropathies at the Elbow Including Radial Tunnel Syndrome

Radial neuropathies occur secondary to entrapments at any point along the nerve. There are three segments in the area of the elbow prone to radial nerve entrapments, including the radial tunnel. Symptoms are based on the location of the entrapment, but in general include sensory and/or motor findings according to the fibers present in the nerve at that particular location. If the entrapment is sufficiently distal, there will only be sensory findings and no motor weakness. The most noteworthy sensory location is the dorsum of the first webspace. The most common motor findings involve wrist and digit extensor weakness. Pain may be present. Nerve conduction studies demonstrate slowing of nerve conduction as demonstrated by segmental analysis, with inching technique required for precise electrodiagnostic localization. Activity modification and wrist splinting are the initial approach. Surgical release may be necessary in refractory cases.

Ulnar Neuropathies at the Elbow Including Condylar Groove Ulnar Neuropathy and Cubital Tunnel Syndrome

Ulnar neuropathies at the elbow are the second most common peripheral nerve entrapment after carpal tunnel syndrome (CTS). They involve entrapment of the ulnar nerve as it courses past the condylar groove into the cubital tunnel. Entrapment can occur in both the condylar groove and the cubital tunnel. The purported risk factors for entrapment differ between the two locations. "Tardy ulnar palsy" is a specific entity of ulnar neuropathy following medial supracondylar fracture.

Risk factors for condylar groove ulnar neuropathies are thought to include flexed elbow position due to sleep posture, arthritic disorders, joint abnormalities, ganglia, diabetes mellitus, excessive alcohol consumption, repeated pressure on the condylar groove, and sequelae of discrete trauma. Risk factors for cubital tunnel syndrome are thought to include fascial bands in the muscle, muscle hypertrophy, and sleep posture. Cubital tunnel syndrome is thought to potentially occur with sustained, repeated, forceful use, particularly with activities involving elbow hyperflexion, although quality studies supporting this theory are lacking. Symptoms include paresthesias in an ulnar nerve distribution (typically the ulnar half of the fourth and fifth digits). Nocturnal symptoms or exacerbations are common. Pain is relatively common and generally involves the medial elbow.

Diagnosis of an entrapment neuropathy can generally be made on the basis of a careful history and physical examination. Nerve conduction studies can help to localize the problem when inching techniques are used. Because most electrodiagnostic studies omit inching technique, the most precise diagnosis possible in such circumstances is ulnar neuropathy at the elbow. Treating ulnar neuropathy at the elbow empirically as described below can often prevent the need to more precisely define the location of the nerve entrapment. Consideration

[i] Fibrotic tissue is generally considered analogous to scar tissue. It is often a consequence of penetrating trauma. Fascial bands are a similar type of firm connective tissue; however, they may occur without trauma. Either may compress a nerve and cause a peripheral neuropathy.

should be given to avoiding discomfort to the patient and the cost of electrodiagnostic studies until after the failure of empiric treatment.

Initial treatment should be non-surgical. Patients are most commonly treated with elbow splinting, especially nocturnally to prevent hyperflexion. Activity modification to avoid hyperflexion is usually also prescribed. Surgical release, either simple (aka "in situ") decompression or transposition may be necessary if non-operative measures fail.

Summary of Recommendations and Evidence

All chapters include analyses of numerous interventions, whether or not they are approved by the U.S. Food and Drug Administration (FDA). For non-FDA-approved interventions, recommendations are based on the available evidence. This is not an endorsement of their use. Many of the medications recommended are utilized off-label. The following is a general summary of the recommendations contained in this chapter:

Evaluation and Diagnostic Issues

- The elbow joint should be carefully evaluated with a history, physical examination, and focused diagnostic testing. A complete physical examination is recommended, since pain can be referred from the neck, shoulder, or chest.
- The initial elbow examination or consultation of patients with acute, subacute or chronic elbow symptoms should focus on detecting both remedial conditions and any red flags for alternate conditions. The presence of red flags generally requires either urgent testing and treatment or referral for appropriate care.
- In the absence of red flags, the health care provider should prescribe efficacious treatments, monitoring patients for complications, facilitating the healing process, and returning the individual to modified alternative or full-duty work.
- Initial evaluation of elbow joint pain only requires elbow x-rays in some cases depending on history and presentation. X-rays of the neck and shoulder may also be indicated in certain circumstances.
- Diagnostic ultrasound is seldom necessary. However, it may be helpful in select cases involving biceps tendinosis, severe strains, or refractory epicondylalgia.
- Magnetic resonance imaging is particularly helpful for diagnosing osteonecrosis, biceps tendinosis, and biceps tears.
- CT scanning may be helpful in evaluating the patient with a traumatic elbow dislocation or arthroplasty-associated recurrent dislocation.

Patient Education Issues

- Patient education is best accomplished if similar advice is given by all health care team members.
- Patients need reassurance that elbow pain is common and generally resolves with time.
- Work-related and activity modifications are often helpful.
- Biceps tendinosis generally responds well to non-operative management. Serious biceps tears usually require surgical repairs and the majority of patients regain full function. Partial tears require judgment regarding whether operative or non-operative approaches are likely to result in better outcomes for a patient. The need for surgery is thought to increase with the size of the tear.
- Olecranon bursitis and epicondylalgia are common and usually resolve completely.
- Pronator syndrome, radial, and ulnar neuropathies generally have a good prognosis, although some cases require surgery.
- Fractures and dislocations require urgent treatment, and many (especially radial head fractures) have good prognoses. Alternately, complex or compound fractures may have poor prognoses, although nearly all patients have good functional recoveries after treatment.
- Osteoarthrosis generally responds to treatment with NSAIDs or acetaminophen.
- Patients should be encouraged to maintain a high level of function; however, modifications may be helpful in reducing stresses to the elbow.
- Rest and immobilization are discouraged in the management of elbow disorders other than fractures, as they usually cause further disability and prolong treatment.

Occupational Issues

- Patients with elbow fractures may require more time off work, especially if one-handed work is unavailable. In general however, patients should be encouraged to return to normal activity or work as soon as possible. Some situations require modified duty. However, the more activities are reduced, the more time generally required to rehabilitate the patient.
- If elbow pain is present, reduced activity may be necessary if the physical requirements of the job exceed the patient's tolerance.
- Modification of offending or aggravating activity(ies) may require consultation with a qualified professional trained in ergonomic analysis, particularly in the setting of high job-physical demands, especially high force combined with high repetition.
- Work technique may need to be changed to address for example, excessive grip force or sustained wrist extension.
- Ergonomic biomechanical advice on the efficient use of the elbow may be helpful. For example, with lateral epicondylalgia, it may help to lift with palm up and not palm down to reduce stress on the lateral elbow (caused by resisted wrist extension). For medial epicondylalgia, it may be helpful to lift palm down to reduce stress on the medial elbow (caused by resisted wrist flexion).
- A functional capacity evaluation (FCE) can establish appropriate physical capacity for work although results should be interpreted with caution and testing should be preferably conducted by a health professional (e.g., occupational or physical therapist) well experienced in dealing with patients who may self-limit due to pain. Non-physical factors, return to work programs and participatory ergonomics, should be addressed as needed. Empower patients to accept responsibility for managing their recovery.

Adaptive Equipment/Assistive Devices and Other Allied Health Therapies

- Elbow straps (proximal forearm epicondylitis bands) may be helpful for epicondylalgia.
- Wrist splints are often helpful for patients with radial neuropathies and pronator syndrome. Some providers also prescribe wrist splints for lateral epicondylalgia.
- When immobilization is utilized, range-of-motion exercises should usually involve the elbow, wrist, and shoulder to avoid adhesive capsulitis ("frozen shoulder").
- Elbow braces are commonly prescribed for nocturnal use in patients with ulnar neuropathy at the elbow.
- Ice, heat, ultrasound, and other similar modalities are sometimes used for elbow pain in the clinical setting.
- Consider heat and ice as a part of self care at home, particularly in the acute pain setting. Heat/ice should provide temporary relief of symptoms, but can reinforce pain and illness behaviors in persons with chronic pain. While many believe heat is not indicated in the acute phase of many injuries, acute low back pain has been demonstrated to be successfully treated with heat. Quality evidence is lacking to oppose the use of heat for acute injuries.
- There is no evidence to support prolonged and repetitive use of therapeutic modalities (e.g., massage, electrical therapies, manipulation, and acupuncture) result in meaningful, functional improvements. Long-term treatment, particularly if there is no documentation of functional improvement, is not indicated in managing patients with chronic pain.

Exercise Issues

- Graded exercises to assist in achieving a return to normal function are indicated.
- Gentle exercises are useful to regain normal range of motion in the acute pain, chronic pain, and post-operative settings. Stretching exercises are advised particularly when there are functional decrements in range of motion. Aggressive stretching may be contraindicated if symptoms are significantly aggravated. It is also important for patients to understand that while exercises after surgery can have some discomfort, they should not experience significant increase in pain or new onset of swelling.
- Quality studies of exercises for treatment for elbow disorders are lacking. By inference from studies of many other MSDs, conditioning, aerobic and strengthening exercises are likely most helpful for the rehabilitation of most chronic elbow pain conditions. Consultation with a physical or occupational therapist to determine the most appropriate exercises for the patient is in order.

Medications

- Initial management of most elbow pain conditions is with NSAIDs and acetaminophen.
- Topical NSAIDs are effective for epicondylalgia.

- Opioids should be avoided for most patients. Opioids might be needed for managing select patients with acute trauma during the initial post-injury period.
- Glucocorticoid injections are indicated for select use in patients with epicondylalgia, particularly if other treatments have been unsuccessful.

Other Issues

- If significant symptoms causing self-limitations or restrictions persist beyond 4 to 6 weeks, referral for specialty evaluation (e.g., occupational medicine, physical medicine and rehabilitation, or orthopaedic surgery) may be indicated to assist in confirming the provisional diagnosis and in determining further management.
- Non-physical factors (i.e., psychiatric, psychosocial, workplace, or socioeconomic issues) should be investigated and addressed, particularly in cases of delayed recovery or delayed return to work. These factors are often not overt and specific inquiries are required to identify these issues.

It is important to note that many of these conditions, particularly lateral epicondylalgia ("epicondylitis") and other tendinoses, tend to resolve spontaneously (e.g., see "wait and see" groups within studies of corticosteroid injections.(12, 13) Thus, in evaluating research studies, including prospective studies that do not include a placebo control, caution should be exerted as results may be interpreted as showing benefit even when there is not true improvement from the therapy beyond normal spontaneous resolution.

Summary Tables: Recommendations and Evidence

Table 1 summarizes the recommendations from the Evidence-based Practice Elbow Panel for diagnostic testing for elbow disorders. Table 2 is a summary of recommendations for managing these disorders. Table 3 summarizes the recommendations for using ergonomic interventions and return-to-work programs. The recommendations are based on critically appraised higher quality research evidence and on expert consensus observing First Principles when higher quality evidence was unavailable or inconsistent. **The reader is cautioned to utilize the more detailed indications, specific appropriate diagnoses, temporal sequencing, prior testing or treatment, and contraindications that are elaborated in more detail for each test or treatment in the body of this *Guideline* in using these recommendations in clinical practice or medical management.** These recommendations are not simple "yes/no" criteria, and the evidence supporting them is in nearly all circumstances developed from typical patients, not unusual situations or exceptions.

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

Table 1. Summary of Recommendations for Diagnostic and Other Testing for Elbow Disorders

TEST	RECOMMENDATION(S)
Antibodies	Antibody levels to evaluate and diagnose patients with elbow pain that have reasonable suspicion of rheumatological disorder – **Recommended, Insufficient Evidence (I)**. Antibody levels as a screen to confirm specific disorders (e.g., rheumatoid arthritis) – **Strongly Recommended, Evidence (A)**

TEST	RECOMMENDATION(S)
Elbow Arthroscopy	Arthroscopy to evaluate and diagnose patients with elbow pain that have suspicion of intraarticular body, and other subacute or chronic mechanical symptoms – **Recommended, Insufficient Evidence (I)** Arthroscopy for diagnosing acute elbow pain – **Not Recommended, Insufficient Evidence (I)** Arthroscopy for diagnosis or treatment in acute, subacute, or chronic patients with osteoarthrosis in the absence of a remediable mechanical defect such as symptomatic loose body – **Not Recommended, Insufficient Evidence (I)** Arthroscopy with chondroplasty for treatment of osteoarthrosis – **Not Recommended, Insufficient Evidence (I)**
Bone Scans	Bone scanning for select use in acute, subacute or chronic elbow pain to assist in the diagnosis of osteonecrosis, neoplasms and other conditions with increased polyosthotic bone metabolism, particularly where there is more than one joint to be evaluated – **Recommended, Insufficient Evidence (I)** Bone scanning for routine use in elbow joint evaluations – **Not Recommended, Insufficient Evidence (I)**
Computerized Tomography (CT)	Routine CT for evaluation of acute, subacute, or chronic elbow pain – **Not Recommended, Insufficient Evidence (I)** CT for evaluating patients with osteonecrosis or following traumatic dislocations or arthroplasty-associated recurrent dislocations – **Recommended, Insufficient Evidence (I)** CT for those with need for advanced imaging but have contraindications for MRI – **Recommended, Insufficient Evidence (I)** Helical CT for select patients with acute, subacute or chronic elbow pain in whom advanced imaging of bony structures is thought to be potentially helpful – **Recommended, Insufficient Evidence (I)**
C-Reactive Protein, Erythrocyte Sedimentation Rate, and Other Non-Specific Inflammatory Markers	Erythrocyte sedimentation rate and other inflammatory markers for screening for inflammatory disorders or prosthetic sepsis with reasonable suspicion of inflammatory disorder in patients with subacute or chronic elbow pain – **Recommended, Insufficient Evidence (I)**. Ordering of a large, diverse array of anti-inflammatory markers without targeting a few specific disorders diagnostically is not recommended.
Electromyography and Nerve Conduction Studies (Electrodiagnostic Studies (EDS))	EDS to assist in the diagnosis of subacute or chronic peripheral nerve entrapments, including ulnar neuropathies, radial neuropathies and median neuropathies – **Recommended, Insufficient Evidence (I)** Quality EDS to assist in securing a firm diagnosis for those patients without a clear diagnosis – **Recommended, Insufficient Evidence (I)** EDS as one of two methods to attempt to objectively secure a diagnosis prior to surgical release – **Recommended, Insufficient Evidence (I)** EDS for initial evaluation of most patients as it does not change the management of the condition – **Not Recommended, Insufficient Evidence (I)**
MRI	MRI for diagnosing osteonecrosis and ligamentous elbow injuries – **Recommended, Insufficient Evidence (I)** MRI for routine evaluation of acute, subacute, or chronic elbow joint pathology, including degenerative joint disease – **Not Recommended, Insufficient Evidence (I)** MRI for evaluation of biceps tendinosis or ruptures – **Recommended, Insufficient Evidence (I)**

TEST	RECOMMENDATION(S)
X-rays	X-rays for evaluation of acute, subacute or chronic elbow pain – **Recommended, Insufficient Evidence (I)** X-rays to rule out osteomyelitis or joint effusion in cases of significant septic olecranon bursitis – **Recommended, Insufficient Evidence (I)** X-rays that include at least 2-3 views to diagnose elbow fractures – **Recommended Insufficient Evidence (I)** X-rays that include at least 2-3 views for elbow dislocation to rule-out fractures – **Recommended, Insufficient Evidence (I)**. Repeat x-rays after reduction are also recommended. For elbow sprains, x-rays that include at least 2-3 views to rule-out fractures – **Recommended, Insufficient Evidence (I)**. Repeat x-rays are also recommended if there is failure to improve as clinically expected over approximately a week. X-rays for biceps tendinosis or ruptures – **Recommended, Insufficient Evidence (I)**
SPECT and PET	SPECT and PET for diagnosing acute, subacute or chronic elbow pain – **Not Recommended, Insufficient Evidence (I)**
Ultrasound	Diagnostic ultrasound for the evaluation and diagnosis of biceps tendinosis or ruptures – **Recommended, Insufficient Evidence (I)** Diagnostic ultrasound for the evaluation and diagnosis of other elbow disorders, including osteonecrosis, osteoarthrosis, dysplasia, and fractures – **No Recommendation, Insufficient Evidence (I)** Diagnostic ultrasound for the evaluation and diagnosis of ulnar neuropathies at the elbow – **No Recommendation, Insufficient Evidence (I)**
Gram Stain and Culture and Sensitivity	Aspiration of the fluid and analyses including Gram stain and culture and sensitivity to determine infection for olecranon bursitis – **Recommended, Insufficient Evidence (I)**

A = **Strong evidence-base**: Two or more high-quality studies.*
B = **Moderate evidence-base**: At least one high-quality study or multiple moderate-quality studies** relevant to the topic and the working population.
C = **Limited evidence-base**: At least one study of moderate quality.
I = **Insufficient evidence**: Evidence is insufficient or irreconcilable.

*For therapy and prevention, randomized controlled trials (RCTs) or crossover trials with narrow confidence intervals and minimal heterogeneity. For diagnosis and screening, cross sectional studies using independent gold standards. For prognosis, etiology, or harms, prospective cohort studies with minimal heterogeneity.

**For therapy and prevention, well-conducted cohort studies. For prognosis, etiology, or harms, well-conducted retrospective cohort studies or untreated control arms of RCTs.

Table 2. Summary of Recommendations for Managing Elbow Disorders

Elbow Disorder	Treatment with Evidence Rating/Recommendation Level		
	Recommended	**No Recommendation**	**Not Recommended**
Contusion	Education (I) NSAIDs (I) Acetaminophen (I) Ice (I) Compression (I) Range-of-motion exercises (I) Avoidance of immobilization (I)		
Lateral Epicondylalgia (Lateral Epicondylitis)	Restrict patient work to tasks that do not involve high-force, stereotypical hand gripping or pinching or use of high-amplitude vibrating hand-held tools (I) Education (I) NSAIDs for acute, subacute, or chronic lateral epicondylalgia (B)	Massage, including friction massage, for acute, subacute, or chronic lateral epicondylalgia (I) Magnets and pulsed electromagnetic field for acute, subacute, or chronic lateral epicondylalgia (I)	Opioids for acute, subacute, or chronic lateral epicondylalgia (I) Soft tissue mobilization for acute, subacute, or chronic lateral epicondylalgia (C) Manipulation or mobilization for acute,

Elbow Disorder	Treatment with Evidence Rating/Recommendation Level		
	Recommended	**No Recommendation**	**Not Recommended**
	NSAIDs for post-operative lateral epicondylalgia (I) Proton pump inhibitors for patients at substantially increased risk for gastrointestinal (GI) bleeding (A) Misoprostol for patients at substantially increased risk for GI bleeding (A) Sucralfate for patients at substantially increased risk for GI bleeding (B) H2 blockers for patients at substantially increased risk for GI bleeding (C) Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed (I) Acetaminophen or aspirin as 1st-line therapy for patients with cardiovascular disease risk factors (A) Acetaminophen for elbow pain, particularly for patients with contraindications for NSAIDs (I) Topical NSAIDs for acute, subacute, or chronic lateral epicondylalgia (B) Topical NSAIDs for post-operative lateral epicondylalgia (I) Opioids for select treatment of patients with post-operative lateral epicondylalgia (I) Tennis elbow bands, straps, and braces for acute, subacute, or chronic lateral epicondylalgia (I) Cock-up wrist braces for acute, subacute, or chronic lateral epicondylalgia (I) Home exercises for acute, subacute, chronic, or post-operative lateral epicondylalgia (I) Physical or occupational therapy for acute, subacute, chronic, or post-operative lateral epicondylalgia (I) Self-application of heat or cold for acute, subacute, chronic, or post-operative lateral epicondylalgia (I) Iontophoresis with administration of either glucocorticosteroids or NSAIDs for acute, subacute, or chronic lateral epicondylalgia (B) Ultrasound for acute, subacute, or chronic lateral epicondylalgia (C) Acupuncture for select patients with chronic lateral epicondylalgia (I) Glucocorticosteroid injections for highly selective subacute or chronic lateral epicondylalgia (C)	Acupuncture for acute, subacute, or post-operative lateral epicondylalgia (I) Biofeedback for acute, subacute, or chronic lateral epicondylalgia (I) Transcutaneous electrical nerve stimulation for acute, subacute, or chronic lateral epicondylalgia (I) Electrical nerve stimulation for acute, subacute, or chronic lateral epicondylalgia (I) Diathermy for acute, subacute, or chronic lateral epicondylalgia (I) Glucocorticosteroid injections for acute lateral epicondylalgia (I) Platelet-rich plasma injections for acute or subacute lateral epicondylalgia (I) Autologous blood injections for acute or subacute lateral epicondylalgia (I) Periarticular sodium hyaluronate and glycosaminoglycan injections for chronic lateral epicondylalgia (I) Prolotherapy injections for acute, subacute, or chronic lateral epicondylalgia (I) Sonographically guided percutaneous tenotomy for acute, subacute, or chronic lateral epicondylalgia (I)	subacute, or chronic lateral epicondylalgia (C) Extracorporeal shockwave therapy for acute, subacute, or chronic lateral epicondylalgia (A) Phonophoresis for acute, subacute, or chronic lateral epicondylalgia (C) Low-level laser therapy for acute, subacute, or chronic lateral epicondylalgia (B) Botulinum injections for acute, subacute, or chronic lateral epicondylalgia (I) Polidocanol injections for acute, subacute, or chronic lateral epicondylalgia (C)

Elbow Disorder	Treatment with Evidence Rating/Recommendation Level		
	Recommended	**No Recommendation**	**Not Recommended**
	Glucocorticosteroid injections using bupivacaine as an adjunct for subacute or chronic lateral epicondylalgia (C) Platelet-rich plasma injections for chronic lateral epicondylalgia (I) Autologous blood injections for chronic lateral epicondylalgia (I) Surgical lateral epicondylar release for chronic lateral epicondylalgia (I) Radiofrequency microtenotomy for chronic lateral epicondylalgia(C)		
Medial Epicondylalgia (Medial Epicondylitis)	As there is almost no quality literature on medial epicondylalgia, treatment of this condition is by analogy to lateral epicondylalgia (see above) and should be considered "Insufficient Evidence" recommendations.		
Olecranon Bursitis	Education (I) Soft padding of the elbow, soft elbow supports, and ace wraps (I) Modifying activities to avoid direct pressure over the olecranon and allowing time to reabsorb the fluid (I) Aspiration of a clinically infected or questionably infected bursa (I) Surgical drainage (I) Surgical resection of the bursa for chronic bursitis with recurrent drainage (I)	NSAIDs (I) Glucocorticosteroid injections (I)	
Elbow Fractures, Including Non-displaced Radial Head Fractures	NSAIDs and acetaminophen to control pain (I) Elbow slings for non-displaced and occult radial head fractures (I) Casts for non-displaced and occult radial head fractures (I) Casts and cast bracing for other fractures (i) Opioids for select patients with pain (I) Surgical fixation for displaced elbow fractures (I) Education, usually by physical or occupational therapists, for select patients needing education after cast removal (I) Physical or occupational therapy for select patients with functional debilities, or those unable to return to work after cast removal (I)		Routine referral for physical or occupational therapy after cast removal for elbow fracture of otherwise healthy patients who are able to return to work (I)
Elbow Dislocations	Education (I) NSAIDs and acetaminophen (I) Opioids for select patients with pain (I) Posterior elbow splint and slings (I) Anesthetic ,with or without opioid, intraarticular injection(s) either pre-reduction or post-reduction for pain management (I)		

Elbow Disorder	Treatment with Evidence Rating/Recommendation Level		
	Recommended	**No Recommendation**	**Not Recommended**
	Reduction and general anesthesia to facilitate reduction in select patients (I) Surgery to repair elbow joints that either recurrently dislocate or are otherwise unstable after dislocation(s) (I)		
Elbow Sprains	Education (I) NSAIDs and acetaminophen (I) Opioids for select patients with pain from severe elbow sprains (I) Slings (I)		
Biceps Tendinosis (or Tendinitis) and Tears/ Ruptures (see Shoulder Disorders Guideline for Bicipital Tendinosis)	Education (I) NSAIDs and acetaminophen (I) Opioids for select patients with pain from moderately severe to severe biceps tendinosis, particularly with nocturnal sleep disruption. Post-operative patients are also candidates. (I) Slings and splints for biceps tendinosis, ruptures, and post-operative patients (I) Range-of-motion transitioning to strengthening exercises for biceps tendinosis, ruptures, and post-operative patients (I) Surgical repair of distal biceps rupture (I)		
Triceps Tendinosis (or Tendinitis) and Tears/Ruptures	There are no quality studies for this disorder, thus treatment by analogy to biceps tendinoses and tears/ruptures is recommended (see above).		

Elbow Disorder	Treatment with Evidence Rating/Recommendation Level: Recommended	No Recommendation	Not Recommended
Ulnar Neuropathies at the Elbow (including Condylar Groove-Associated Ulnar Neuropathy and Cubital Tunnel Syndrome)	Removal from job tasks with repeated or sustained elbow hyperflexion (I) Education (I) Patients should be taught to sleep with elbows extended rather than flexed (I) Patients should avoid hyperflexed (>90º) elbow postures at work or during avocational activities (I) Exercise for rehabilitation of patients with post-operative ulnar neuropathy at the elbow with significant deficits (I) NSAIDs and acetaminophen for post-operative pain management of ulnar neuropathy-related pain (I) Limited use of opioids for a few days to a couple weeks for select patients who have undergone recent ulnar neuropathy surgery, particularly if complications have occurred (I) Nocturnal elbow splinting or bracing for acute, subacute, or chronic ulnar neuropathies at the elbow (I) Ultrasound for acute, subacute, or chronic ulnar neuropathies (I) Simple (aka "in situ") decompression for patients who fail non-operative treatment for subacute or chronic ulnar neuropathies or patients who have emergent or urgent indications (e.g., acute compression due to fracture, arthritides or compartment syndrome with unrelenting symptoms of nerve impairment). (C) Anterior subcutaneous transposition for patients who fail non-operative treatment for subacute or chronic ulnar neuropathies or patients who have emergent or urgent indications (e.g., acute compression due to fracture, arthritides or compartment syndrome with unrelenting symptoms of nerve impairment). (I) Medial epicondylectomy for patients who fail non-operative treatment for subacute or chronic ulnar neuropathies or patients who have emergent or urgent indications (e.g., acute compression due to fracture, arthritides or compartment syndrome with unrelenting symptoms of nerve impairment). (I)	Exercises for acute, subacute, or chronic ulnar neuropathy at the elbow (I) Oral or injections (condylar groove or cubital tunnel) of glucocorticosteroids for acute, subacute, or chronic ulnar neuropathies at the elbow. There is no indication for injecting steroids into the cubital tunnel as is done for the carpal tunnel as there is no other structure than the ulnar nerve in the tunnel and steroid injection into the nerve may cause damage. (I) Other vitamins for acute, subacute, or chronic ulnar neuropathies (I) Lidocaine patches for acute, subacute, or chronic ulnar neuropathies with pain (I) Topically administered ketamine for acute, subacute, or chronic ulnar neuropathies with pain (I) Acupuncture for acute, subacute, or chronic ulnar neuropathies at the elbow (I) Biofeedback for acute, subacute, or chronic ulnar neuropathies at the elbow (I) Manipulation and mobilization for acute, subacute, or chronic ulnar neuropathies at the elbow (I) Massage for acute, subacute, or chronic ulnar neuropathies at the elbow (I) Soft tissue massage for acute, subacute, or chronic ulnar neuropathies at the elbow (I) Iontophoresis for acute, subacute, or chronic ulnar neuropathies at the elbow (I) Phonophoresis for acute, subacute, or chronic ulnar neuropathies at the elbow (I)	NSAIDs and acetaminophen as a primary treatment for acute, subacute, or chronic ulnar neuropathies at the elbow (I) Routine use of opioids for acute, subacute, or chronic ulnar neuropathies at the elbow (I) Pyridoxine for routine treatment of acute, subacute, or chronic ulnar neuropathies in patients without vitamin deficiencies (I) Magnets for management of pain for acute, subacute, or chronic ulnar neuropathies (I) Low-level laser therapy for acute, subacute, or chronic ulnar neuropathies (I) Anterior submuscular transposition for subacute or chronic ulnar neuropathies (I)
Radial Nerve Entrapment (including Radial Tunnel Syndrome)	In the absence of quality evidence for treatment of these radiculopathies, it is recommended that the treatments for ulnar neuropathy at the elbow (see above) be used to infer treatment for radial neuropathies.		

Elbow Disorder	Treatment with Evidence Rating/Recommendation Level		
	Recommended	No Recommendation	Not Recommended
Pronator Syndrome (Median Neuropathies in the Forearm)	In the absence of quality evidence for treatment of these radiculopathies, it is recommended that the treatments for ulnar neuropathy at the elbow (see above) be used to infer treatment for median neuropathies present in the forearm, such as pronator syndrome.		

A = **Strong evidence-base**: Two or more high-quality studies.*
B = **Moderate evidence-base**: At least one high-quality study or multiple moderate-quality studies** relevant to the topic and working population.
C = **Limited evidence-base**: At least one study of moderate quality.
I = **Insufficient evidence**: Evidence is insufficient or irreconcilable.

*For therapy and prevention, randomized controlled trials (RCTs) or crossover trials with narrow confidence intervals and minimal heterogeneity. For diagnosis and screening, cross sectional studies using independent gold standards. For prognosis, etiology, or harms, prospective cohort studies with minimal heterogeneity.
**For therapy and prevention, well-conducted cohort studies. For prognosis, etiology, or harms, well-conducted retrospective cohort studies or untreated control arms of RCTs.

Table 3. Summary of Recommendations for Ergonomic Interventions for Elbow Musculoskeletal Disorders with an Occupational Basis and Return-to-Work Programs

Recommended	No Recommendation	Not Recommended
In settings with combinations of risk factors (e.g., high force combined with high repetition), ergonomic interventions are recommended to reduce risk factors for epicondylalgia (I) In settings with sustained or repeated hyperflexion of the elbow (>90°), ergonomic interventions are recommended to reduce elbow flexion (I) Ergonomics training in moderate- or high-risk manufacturing settings (I) Return-to-work programs for treatment of subacute or chronic elbow MSDs, particularly for patients with significant lost time (I)	Return-to-work programs for acute, severe elbow MSDs (I)	

A = **Strong evidence-base**: Two or more high-quality studies.*
B = **Moderate evidence-base**: At least one high-quality study or multiple moderate-quality studies** relevant to the topic and the working population.
C = **Limited evidence-base**: At least one study of moderate quality.
I = **Insufficient evidence**: Evidence is insufficient or irreconcilable.

*For therapy and prevention, randomized controlled trials (RCTs) or crossover trials with narrow confidence intervals and minimal heterogeneity. For diagnosis and screening, cross sectional studies using independent gold standards. For prognosis, etiology, or harms, prospective cohort studies with minimal heterogeneity.
**For therapy and prevention, well-conducted cohort studies. For prognosis, etiology, or harms, well-conducted retrospective cohort studies or untreated control arms of RCTs.

Basic Principles and Definitions

Acute, Subacute and Chronic Pain: For purposes of identifying interventions at different stages of diseases, acute pain is defined as pain for up to a 1 month duration, subacute pain is from 1 to 3 months duration, and chronic pain is over 3 months duration (see Chronic Pain chapter 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 activities and muscle reconditioning (weight lifting or resistance training),(14) activities of daily living, community reintegration, and cognitive therapy. Some authors include active stretching and treatment with psychological, social and/or educational components requiring active participation from the patient.(15)

Active Exercise Therapy: Active exercise therapy typically consists of cardiovascular training and muscle strengthening,(16, 17) although it may also include progressive or occasionally even active stretching, especially in patients with substantially reduced ranges of motion. Active exercise therapy is used as a primary treatment for chronic pain, is frequently initiated in the course of treating subacute pain, and is a primary treatment after various surgeries. The goal of active exercise therapy is to improve function.(16) 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 very little effort or investment on the part of the patient or provider.

Allied Health Therapies: There are a number of treatment approaches that require extensive training and development of specific skills. The treatment approaches in this category include manipulation, mobilization, massage, and acupuncture.

Bursae: Fluid-filled sacs within the body which provide lubrication in areas, such as points where muscles move over bony projections.

Bursitis: Bursitis occurs when the bursae become inflamed and irritated. This results in pain when the overlying muscle is used. It may occur from a number of exposures, including when there is trauma, bumping the elbow, direct pressure, or with forceful and unaccustomed use usually involving leaning on the elbow.

Delayed Recovery: This is most commonly defined as an increase in the period of time prior to returning to work or to usual activities, when compared with the length of time expected, based on reasonable expectations, disorder severity, age, and treatments provided.

Elbow Dislocation: Elbow dislocations are relatively uncommon and they usually result from a violent or high-speed collision or from falls. Pain is usually severe, associated with an inability to use the arm. Most other dislocations in adults occur due to either a congenital malformation of the elbow joint or recurrent dislocations associated with ligamentous laxity.

Elbow Joint: The elbow joint is a synovial hinge type joint based on the articulation of the ulna and the trochlea of the humerus. Ligaments support the joint. Absent ligamentous laxity or prior dislocations, dislocation of the elbow joint is difficult in adults due to the lack of joint laxity and typically requires considerable force. By contrast, dislocation of the radial head in young children is common and requires considerably less force.

Elbow Pain: Pain originating from the elbow is usually felt in the center of the joint and generally does not radiate. Pain in the elbow may also be due to referred pain from cardiovascular or metastatic processes, cervical or upper thoracic disc herniation with neurological impingement, and chest disorders including arteriosclerotic disorders.

Enthesitis: "Irritation" of the muscular or tendinous attachment to bone, usually related to high force use, particularly if unaccustomed. Signs of traditional inflammation are not present, thus the suffix produces a misnomer despite widespread use.

Enthesopathy: Disorder of the muscular or tendinous attachment to bone.

Epicondylitis: Pain at the lateral or medial epicondyle of the elbow (humerus) from any cause. Traditional signs of inflammation are absent.The more accurate term for this condition is epicondylalgia, as classic inflammation is absent and histopathological findings of degenerative changes are common.(9, 18-21)

Epicondylalgia: Pain in the epicondyle from any cause (it can be located at the origin of a tendon or be referred).

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.(22) An FCE may be done to identify a person's ability to perform specific job tasks associated with a job – job-specific FCE, or his/her ability to perform physical activities associated with any job – general FCE (see Chronic Pain and Low Back Disorders chapters).

Functional Improvement (especially Objective Evidence): Entails tracking and recording evidence that the patient is making progress towards increasing his or her functional state. Validated tools are preferable.

Functional Restoration: A term initially used for a variant of interdisciplinary pain alleviation or at least amelioration characterized by objective physical function measures, intensive graded exercise and multi-modal pain/disability management with both psychological and case management features.(23-29) The term has become popular as a philosophy and an approach to medical care and rehabilitation. In that sense, the term refers to a blend of various techniques (physical and psychosocial) for evaluating and treating the chronic non-malignant pain patient, particularly in the workers' compensation setting (see Chronic Pain chapter).

Inflammation: A localized protective response elicited by an injury or destruction of tissues, which serves to destroy, dilute, or wall off (sequester) both the injurious agent and the injured tissue. Inflammation is characterized in the acute form by four classical signs: 1) pain (dolor); 2) heat (calor); 3) redness (rubor); and 4) swelling (tumor). Loss of function (functio laesa) may also occur. Histologically, inflammation involves a complex series of events, including dilatation of arterioles, capillaries, and venules, with increased permeability and blood flow; exudation of fluids, including plasma proteins; and leukocytic migration into the inflammatory focus. Classic inflammatory responses are found in infectious diseases. Most elbow disorders exhibit only one classic sign of inflammation(30) – that of pain; therefore, these disorders do not qualify as an acute inflammatory process in which three of the four classical signs must be present.

Olecranon Bursa: The olecranon bursa lies between the olecranon process and overlying dermis.

Olecranon Bursitis: Olecranon bursitis occurs when the trochanteric bursa is "inflamed," although in most cases, there are not classic symptoms and signs of inflammation. Classic inflammation may occur in the olecranon bursa with arthropathies or infectious agents. Patients usually complain of swelling over the point of the elbow (olecranon process). Pain may or may not be present, and if marked, suggests an inflammatory condition such as infection or crystal arthropathy. The elbow joint itself is not involved. The condition is thought to occur either as a result of an acute trauma such as a fall, bump or blow, or leaning on the elbow.

Osteonecrosis [Avascular Necrosis (AVN)]: Osteonecrosis occurs when the tenuous blood supply to the bone is interrupted. Osteonecrosis can be a result of traumatic or nontraumatic factors and most commonly occurs in the femoral and humeral heads. Barotrauma (i.e., rapid decompression) is the most common known occupational factor. The condition is painless in its early stages, but when it advances, patients generally present with pain and limitation of motion. Pain is usually exacerbated by use and relieved with rest.

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

Passive Modality: Various types of provider-given treatments in which the patient is passive. These treatments include medication, injection, surgery, allied health therapies (e.g., massage, acupuncture, manipulation), and various physical modalities such as hydrotherapy (e.g., whirlpools, hot tubs, spas), ultrasound, TENS, other electrical therapies, and heat and cryotherapies.

Primary Prevention: Primary prevention involves preventing the condition or risk factor from developing (e.g., physical activity programs to prevent obesity which results in osteoarthrosis.

Rehabilitation: 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 and licensed individuals such as physicians, occupational therapists, and physical therapists. Sometimes mental health professionals are incorporated in the treatment team, particularly for select chronic pain patients. Jurisdictions may differ on qualifications for licensure to perform rehabilitative evaluations and interventions.

Secondary Prevention: Secondary prevention involves reduction in exposure or risk factor after the risk factor has already developed, but before the disease has occurred (e.g., use of fall protection equipment to prevent fractures).

Sprain: Disruption of a joint's ligaments. The mechanism involves an acute, high-force deviation of the joint beyond the normal range of motion.

Strain: Disruption of a myotendinous junction, usually from a high force, unaccustomed exertion(s). 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.

Synovitis: Synovitis refers to inflammation of a synovial membrane, although in most cases, there are not classic symptoms and signs of inflammation. Classic inflammation occurs however with crystalline arthropathies or infectious agents. Synovitis is usually painful, especially with motion. Fluctuating swelling may occur due to effusion within the synovial sac.

Synovial Membrane: The synovial membrane incorporates the entire femoral head, the anterior neck, and the proximal half of the posterior neck of the femur.

Tendinitis: This term has been used to denote a tendon abnormality usually accompanied by pain and tenderness over the tendon or tendon origin/insertion on examination. Infrequently, there may be warmth or swelling. However, tendinitis implies “inflammation,” and there is scientific agreement that classic signs of inflammation are absent in nearly all cases. More commonly, there may be signs of mild inflammation. Therefore, the term “tendinitis” is often replaced by the more accurate term “tendinosis.” There is also some suboptimal use of the term “tendinitis” among some practitioners to label nonspecific pain with tendinitis.

Tendinosis: A tendon disorder that most commonly consists of an underlying, chronic degenerative tendon condition. When symptomatic, there usually is pain and tenderness over the tendon. Some warmth may be present, but redness is usually absent. It may be associated with limited movement.(21, 31) Tendinosis is believed to usually occur due to an interaction of individual and physical factors, which may include vocational and avocational activities. Tendinoses are the most common types of musculoskeletal disorders, likely outpacing arthroses. The severity of these disorders is thought to be influenced by numerous factors including:

- The person’s age, presence of various medical conditions and habits, level of fitness, and general health (chronic tendon degeneration is more common with age).(32) Poor fitness is theorized to make physical injuries more common.
- The amount of forceful use and lack of recovery time (e.g., hours of work per day, per week, and per month as well as number of breaks per day).(2, 33, 34)
- The person’s genetics (e.g., a higher initial Type III/Type I collagen ratio in the tendons).
- Potential ergonomic risk factors associated with musculoskeletal disorders (i.e., excessive force, repetition, sustained exertion, vibration, improperly fitted tools or sports equipment, or poor technique).(2, 33, 34)

Tendinosis is also associated with cardiovascular disease risk factors in the shoulder’s rotator cuff, thus as extensive array of additional individual risk factors, though as yet largely undefined, may also be operant for this condition at the elbow (see Shoulder Disorders chapter).

Tenosynovitis: Tenosynovitis is most commonly used to refer to pain generated from the sheath and structures surrounding a tendon. The term technically refers to inflammation of a tendon sheath although in most cases there are not classic symptoms and signs of inflammation. Classic inflammation may occur with inflammatory arthropathies, such as rheumatoid arthritis, or with infections. The term should be avoided for elbow disorders as tendon sheaths are absent in this body region.

Tertiary Prevention: Tertiary prevention has most typically been defined as amelioration of the condition after it has already developed. For example, after a patient has osteonecrosis, precluding them from diving or other decompression activities is a method of tertiary prevention.

Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC): Most common outcome measure other than standard pain ratings and Visual Analog Scale (VAS) pain ratings. It combines subjective ratings of pain with activities, stiffness, physical function, social function and emotional function measures.(35)

VARYING SUSCEPTIBILITY TO TENDINOSES

Individuals seem to vary in their susceptibility to tendinoses with some never apparently experiencing this condition. Many people experience mild tendon problems, but recover. Others develop chronic tendinosis that is not infrequently attributed to physical exertion. Many individuals develop chronic tendon injuries in multiple places of the body. Usually, a careful medical history will reveal some contributing associated factor(s), but tendon injury occasionally occurs without an obvious cause.

Theoretically, the tendinosis cycle begins when breakdown exceeds repair. One theory is that physical exertion causes micro-injuries that accumulate with time. The tensile strength of collagen is exceeded, and the tendon tries to repair itself, but the cells produce new collagen with an abnormal structure and composition. The new collagen has an abnormally high Type III/Type I ratio. Experiments have shown that the excess Type III collagen at the expense of Type I collagen weakens the tendon, making it prone to further injury. Part of the problem may be that the new collagen fibers are less organized into the normal parallel structure, making the tendon less able to withstand tensile stress along the direction of the tendon.(36) Therefore, according to this theory, tendinosis is a slow accumulation of minor injuries that are not repaired properly and that leave the tendon vulnerable to additional injury. This failed healing process may be one reason why some people with tendinosis do not completely clinically heal following an injury and encounter difficulties in returning to their previous level of activity. Once the tendinosis cycle starts, the tendon is believed to rarely heal back to its pre-injury state, although many patients appear to clinically resolve.

Relative rest is thought to be an essential part of the acute healing process for tendinosis, too much rest causes deconditioning of muscles and tendons. Also, some individuals heal without any change in physical activities. The weaker muscles and tendons leave the area more vulnerable to injury. Thus, the area may become weaker on a large scale as well as on a cellular scale. This cycle of injury/rest/deconditioning/more injury may be difficult to break. Gradual, careful physical exercises are believed to be most effective.

Initial Assessment

The physician performing an initial evaluation of a patient with elbow pain or other symptoms should seek a discrete explanatory diagnosis (see General Approach to Initial Assessment and Documentation chapter). A careful, thorough history is required.(37, 38) Review of systems that also involves the hand, shoulder, spine, and chest is necessary. The examination of the patient with elbow symptoms generally needs to focus on the elbow joint and include relevant neighboring structures similar to the review of systems. Findings of the medical history and physical examination can alert the physician to other pathology that presents with pain or other constitutional symptoms. Certain findings, referred to as red flags, raise suspicion of serious underlying medical conditions (see Table 4. Red Flags for Potentially Serious Elbow Disorders). Potentially serious disorders include infections, tumors, and systemic rheumatological disorders. The absence of red flags generally rules out the need for special studies, referral, or inpatient care for many patients during the first 4 weeks when spontaneous improvement or recovery is expected.

Elbow disorders may be classified into one of four working categories (note, these categories are somewhat arbitrary with significant overlap between the groups):

- **Potentially serious elbow disorders:** Fracture, acute dislocation, infection, or neurovascular compromise. These disorders are usually associated with trauma.
- **Mechanical disorders:** Derangements of the elbow that are related to acute trauma, such as ligament sprain or tears, contusions, or bursitis. Many musculoskeletal disorders are often categorized as mechanical disorders, although there is evidence that these disorders may be associated with degenerative changes.
- **Degenerative disorders:** Consequences of aging, medical conditions, or forceful, or prolonged physical exertion, or a combination thereof. This category includes tendinoses.
- **Non-specific disorders:** Self-limiting disorders in the absence of objective physiological findings. Non-specific disorders do not suggest necessarily internal derangement or referred pain.

Table 4. Red Flags for Potentially Serious Elbow Disorders

Disorder	Medical History	Physical Examination
Fracture	History of significant trauma Fall on outstretched hand Fall onto lateral elbow	Deformity consistent with fracture Reduced range(s) of motion Pain with range of motion Disturbance in the triangular relationship between the olecranon and the epicondyles Significant bruising, if subacute (unusual)
Dislocation	History of fall/trauma as above History of deformity with or without spontaneous reduction	Deformity consistent with dislocation Hemarthrosis

Disorder	Medical History	Physical Examination
Infection	Pain, swelling, redness Diabetes mellitus History of immunosuppression (e.g., transplant, chemotherapy, HIV) History of systemic symptoms	Localized heat, swelling, erythema Purulence Erythematous streaks, especially from a portal of entry Systemic signs of infection
Tumor	History of cancer Unintentional weight loss Continuous pain, especially at night and not improved with rest	Palpable mass not consistent with usual diagnoses
Inflammation	History of gout or pseudogout History of rheumatoid arthritis History of other inflammatory arthritides	Effusion Localized heat, swelling, erythema, tenderness
Rapidly Progressive Neurologic Deficit	History of neurologic disease Trauma	Abnormal neurologic examination Focal or global motor weakness distal to the elbow Weakness may be limited to one nerve, such as hand intrinsic muscles
Vascular Compromise	History of diabetes mellitus Tobacco use History of fracture or dislocation History of vascular disease of any kind	Decreased or absent peripheral pulses and delayed capillary refill Edema
Compartment Syndrome(39, 40)	History of trauma, surgery or extreme unaccustomed forceful activity Persistent forearm pain and "tightness" Tingling, burning, or numbness	Palpable tenderness and tension of involved compartment Pain intensified with stretch to involved muscles Paresthesia, paresis, and sensory deficits Diminished pulse and prolonged capillary refill

Medical History and Physical Examination

Medical History

The medical history is usually the most important aspect in the evaluation of a patient. Many disorders of the elbow will be diagnosable with a high degree of accuracy prior to examination based upon a careful medical history. Of critical importance in the occupational setting is the recording of the patient's report of the mechanism(s) of injury. An accurate record is also often critical in subsequent case review. Asking the patient open-ended questions, such as those that follow, allows the physician to gauge the need for further information. Discussion or more specific inquiries will usually produce the detail necessary for clinical decision-making. It may be helpful to use standardized questionnaires such as the DASH (Disabilities of the Arm, Shoulder and Hand)(41) (outcome measure or the Upper Extremity Function Scale for Upper Extremity Disorders.(42)

Questions that should be asked as part of the examination:

1. **What are your symptoms?**
   - Do you have pain, weakness, limited motion, or locking with movement?
   - For traumatic injuries: How did the injury occur? What was the exact mechanism? Was the area deformed? Did you lose any blood or have an open wound?
   - Are your symptoms located primarily in the elbow? Do you have pain or other symptoms elsewhere (e.g., neck, shoulder, forearm, or hand)?
   - Are your symptoms constant or intermittent?
   - What makes the problem worse or better?
   - How did your symptoms start? Was there an event that precipitated the symptoms?
   - How do your symptoms limit your work performance?
   - Have your symptoms changed? How?

2. **How did your condition develop?**

   PAST:
   - Have you had previous similar episodes?
   - Have you had previous testing or treatment?

- What treatments did you receive?
- With whom?
- Were the treatments effective?

CAUSE:
- What do you think caused the problem?
- How do you think it is related to work?

JOB:

OCCUPATIONS AND ACTIVITIES:
- What are your specific job duties?
- Do you use your elbow to perform these duties? How? How often?

NON-OCCUPATIONAL ACTIVITIES:
- What are your leisure activities (e.g., tennis, golf, etc.)?
- Do you use your elbow to perform these leisure activities? How? How often?
- What instrumental activities of daily living (i.e., IADLs) do you perform (e.g., housecleaning, gardening, carpentry repairs, etc.)?

3. **How do these symptoms limit you?**
   - Which hand do you use to write or use tools?
   - Can you flex your elbow to work or accomplish activities of daily living (i.e., brush your teeth, feed yourself, shower/bath, comb your hair, dress yourself)? For how long?
   - Do you have trouble turning a doorknob or using a screwdriver (pronation/supination)?
   - Can you lift a heavy object? How much weight can you lift?
   - Can you carry a shopping bag with handles, heavy purse, or briefcase on the affected side?
   - How long have your activities been limited?
4. **Do you have other medical problems?**
   - Do you have any autoimmune, infectious, or metabolic diseases such as rheumatoid arthritis or gout?
   - Do you have arthritis in any joints?
   - Do you smoke?
   - Do you have diabetes or HIV?
   - Do you have fibromyalgia, other musculoskeletal problems, or chronic pain?
   - Have you ever had cancer?
5. **What are your expectations regarding your return to work and disability from this health problem?**
6. **What are your concerns about the potential for further injury to your elbow as you recover?**
7. **How do you like your job? Your supervisor and coworkers? What is your relationship with your co-workers and supervisor and how do they treat you?**
8. **What do you hope to accomplish during this visit?**

Physical Examination

Guided by the medical history, the physical examination should include:
- General observation of the patient
- Focused examination of the forearm, arm, elbow, and shoulder with discussion of the symptoms
- Neurovascular assessment

The physician should seek objective evidence including signs of pathology that are consistent with the patient's subjective complaints. In many cases, careful examination will reveal one or more truly objective findings, such as swelling, deformity, atrophy, reflex changes, or spasm.(43)

Subjective Evidence: Symptoms

Subjective symptoms are perceptible only to the patient. Examples of subjective findings include pain, tenderness to palpation, numbness and tingling, pain-limited decreased range of motion, and weakness.

Objective Evidence: Signs

A sign is any objective evidence of a disease. Examples of objective evidence signs include visible changes, swelling, deformity, redness, heat, reflex changes, spasm, palpable changes, atrophy, nonresistant passive range of motion, and imaging findings. Such evidence is perceptible to the examining physician, as opposed to the subjective sensations (symptoms) of the patient.(30) Objective evidence should be thoroughly documented in the medical record especially for reference during future visits. For most patients with elbow disorders, no truly objective physical examination evidence exists. Therefore, meticulous documentation of the patient's symptoms at each visit is particularly important.

Accurate interpretation of physical examination findings requires the physician to be cognizant of the interplay between the performance of many physical examination techniques and the patient's responses. A number of physical examination findings are actually a combination of objective and subjective evidence. Compliance with the maneuver or a patient response is required for the interpretation of the results. Examples include tenderness on palpation, reflexes, or ranges of motion or elicitation of pain with a maneuver (such as resisted wrist extension inducing lateral or medial elbow pain).

Anatomy

The elbow has four basic movements – flexion, extension, pronation, and supination. From a functional perspective of the muscles, the physician may look at the elbow based on the three main groups of muscles/tendons:

1. Those that attach to the lateral epicondyle or condyle – extend the wrist and supinate the elbow.
2. Those that attach to the medial epicondyle or condyle – flex the wrist and pronate the elbow.
3. Those that cross the elbow from the upper arm or shoulder – flex and extend the elbow and also supinate and pronate, but do not insert into it (except for triceps into the olecranon).

While there are many muscles and tendons associated with elbow and wrist movement, this chapter will only address those that commonly cause elbow pain or produce referred pain to the elbow.(44)

Flexion of the elbow: The main flexors are the biceps brachii, brachialis, and brachioradialis.(37) The long head of the biceps brachii originates on the supraglenoid tuberosity, while the short head originates on the coracoids process and insertions are on the tuberosity of the radius and bicipital aponeurosis to the fascia of the forearm. The brachialis muscle arises from the lower half of the anterior humerus and inserts on the tuberosity and coronoid process of the ulna. The brachioradialis muscle originates on the lateral supracondylar ridge and inserts on the radial styloid. Pertaining to the elbow, other than epicondylalgia, the biceps brachii are most often involved in clinical tendinoses and ruptures.

Extension of the elbow: Triceps muscles (long, medial, and lateral heads) are the main elbow extensors. They originate from the infraglenoid tuberosity of the scapula, posterior aspect of the humerus and lateral aspect of the humerus. They insert on the posterior and upper olecranon and fascia of the forearm. The anconeus originates from the posterior aspect of the lateral epicondyle, inserts on the olecranon and upper posterior ulna, and is a minor elbow extensor. Triceps tendinoses of the elbow occur, but are not clinically common in employed populations.

Supination: The biceps is the main supinator. The supinator muscle also supinates the hand. The supinator originates on the lateral epicondyle and ulna below the radial notch. It inserts on the radial tubercle and oblique line of the radius.

Pronation: Pronation is accomplished by the pronator teres and pronator quadratus. The pronator teres originates above the medial epicondyle and medial side of the coronoid process of the ulna and inserts on the lateral side of the radius. The pronator quadratus originates on the lower anterior shaft of the ulna and inserts on the medial anterior surface of the distal radius.

A. Focused Elbow Examination

The physician should examine both elbows for comparison and differences should be noted beginning with careful observation. This should include inspection for visible changes, swelling, deformity, redness, heat, spasm, and atrophy. Atrophy of the muscles of the ulnar or radial hand intrinsic muscles is an objective finding, arising only after weeks to months of disuse or denervation. Deformities may include claw phenomenon. Deformities due to fractures are often subtle. Dislocations may be associated with visible, objective abnormal findings. Signs of infection or inflammation (redness, heat, swelling, tenderness, etc.) or gross tumor (palpable mass) may also be obvious.

Next, active range of motion is assessed. If active range of motion is limited, then passive range of motion is assessed to help determine if the limitation appears fixed or is rather painful or otherwise limited. Movements to evaluate limitation include elbow flexion and extension, forearm pronation and supination, wrist flexion, extension, and ulnar and radial deviation. Limitation of motion or pain at the extremes of flexion or extension suggests an intra-articular abnormality or at least a joint-associated abnormality. An apparent loss of motion in one elbow may be equally present in the non-affected limb, indicating either a congenital problem or voluntary limitation of movement, which in either case would be unrelated to a unilateral injury.

Particularly in the setting of trauma, tests for joint integrity are necessary. These tests include assessment for instability of the elbow including the pivot shift test for posterolateral instability (lateral ulnar collateral ligament), and valgus and varus tests.

Palpation is performed on the elbow to ascertain points of tenderness. Palpation is also performed to detect swelling, tumors, osteophytes, and other abnormalities. Individuals with lateral epicondylalgia tend to have tenderness over the epicondyle proper, the radial head, and/or two centimeters distant to the epicondyle.(42, 43, 45, 46) Similarly, those with medial epicondylalgia tend to have tenderness either over the epicondyle and/or several centimeters distal.(45) Muscle-strength testing is often helpful. However, weakness in the absence of atrophy is particularly difficult to assess. Pain-limited weakness is common and makes determination of true muscular weakness substantially more difficult. Weakness on the unaffected side should be noted.

Reflexes help to detect abnormalities in nerves, nerve roots, spinal cord, and higher level functioning. Sensory examination of the elbow includes fine touch, two-point discrimination, and vibratory sense and position sense in the distal extremity. For the vast majority of common elbow problems, a full sensory examination is not required. However, when symptoms that could represent a nervous system disorder are present, appropriate examination is necessary.
The physician should generally examine one joint above and below the joint being examined, particularly if symptoms are present elsewhere. Thus, examination of the shoulder and forearm are required. Examination of the neck is also required in many evaluations of the elbow to exclude cervical pathology as it is a common source of patients' elbow complaints. Special examination maneuvers are performed to help diagnose an elbow disorder.(37, 47) Common maneuvers include:

- **Resisted wrist extension.** Performed with the shoulder forward flexed approximately 60 degrees and the arm extended, this maneuver will produce pain in the lateral elbow in patients with lateral epicondylalgia.
- **Resisted wrist flexion.** Pain is produced in the medial elbow in those with medial epicondylalgia.
- **Resisted middle finger extension.** Performed similarly to resisted wrist extension, pain is produced in the lateral elbow with resisted middle finger extension and is indicative of lateral epicondylalgia. Some consider this sign more important in radial tunnel syndrome, but quality studies documenting this do not exist and it is positive in many patients with lateral epicondylalgia.
- **Resisted supination.** This maneuver is positive for weakness in those with ruptures of the biceps tendon, biceps tendinoses, musculocutaneous nerve, C5 or C6 nerve root problems. Patients with lateral epicondylalgia and biceps tendinoses will tend to have pain with this maneuver.
- **Resisted pronation.** This maneuver demonstrates weakness in those with rupture of the pronator origin from the medial epicondyle, and median nerve, C6 and C7 nerve root problems. Patients with medial epicondylalgia will tend to have pain with this maneuver.
- **Shaking hands sign.** Patients with significant lateral epicondylalgia will tend to have reproduction of their pain with a firm handshake. This test may also be positive with radial nerve entrapment.

Another test used to diagnose elbow disorders is the Hoffman-Tinel's test. However, it should be noted that this test is increasingly thought to have low value in the diagnosis of any peripheral neuropathy.

B. Neurovascular Screening

Physicians should assess the neurological and vascular status of the elbow and distal upper extremity, especially following dislocation, fractures, or other substantial trauma or if other symptoms suggest the need for this evaluation. Evidence of problems with the median, ulnar, and radial nerve distributions should be sought. Evaluation for evidence of cervical disc disease associated with radiculopathy that radiates to the elbow should also be performed. C5 radiculopathy may result in weakness of elbow flexion, and T1 lesions may weaken the hand intrinsic muscles in a manner that is similar to entrapment of the ulnar nerve. C6 radiculopathy can cause lateral elbow pain, and as noted above, should be considered in the differential diagnosis of lateral elbow pain. Concomitant neck pain or stiffness, and/or thumb tingling can be helpful indications in that differential analysis. Both left and right sides should be examined for consistency.

C. Assessing Red Flags

Physical examination evidence of neurovascular compromise, fracture, unreduced dislocation, infection, or tumor that correlates with the medical history and with test results may indicate a need for immediate treatment and/or consultation. The examination may further reinforce or reduce suspicion of these diagnoses.

Work-Relatedness

A determination of work-relatedness requires a careful history regarding occupational physical factors, non-work activities, individual or personal factors, and psychosocial, psychiatric, and other risk factors, as well as a thoughtful careful assessment of the relative contribution each makes to the patient's problem while incorporating epidemiological evidence (see Work-Relatedness chapter). However, many conditions have no apparent cause and thus are defined as idiopathic.

Acute occupational elbow injuries related to a specific acute traumatic event are non-controversial, the location of that event determines work-relatedness. Most jurisdictions also request an opinion from physicians as to whether a disease or disorder should be considered work related for the purpose of a workers' compensation claim. Physicians need to remember that their role is to supply opinion and that the medical/scientific answer and the legal answer as determined by regulations and case law precedents in a particular jurisdiction (workers' compensation system) are different (see Work-Relatedness chapter). With some noteworthy exceptions, there are few if any quality epidemiological studies supporting work relatedness for many elbow disorders. Thus, aside from these specific circumstances (e.g., occupational fractures and other acute trauma, biceps ruptures from a maximal lift, osteonecrosis from barotraumas, lateral epicondylitis when performing stereotypical high-force work, olecranon bursitis after a fall on the elbow), most opinions are speculative.

Biceps Strains and Ruptures

Biceps strains and ruptures involve myotendinous strains in the biceps insertion(s) at the elbow. Symptoms usually occur acutely and are associated with a maximal forceful use. These injuries are considered more analogous to acute injuries than diseases, although repeated unaccustomed use may have precipitated the event. Thus, the nature of the forceful unaccustomed use determines whether the condition is work-related.

Elbow Dislocations, Fractures and Sprains

Elbow dislocations, fractures, and sprains are consequences of significant trauma. The mechanism of the trauma determines whether the condition is work-related.

Elbow Osteoarthrosis

Elbow osteoarthrosis is not well investigated epidemiologically. By analogy to other joints, it would be expected that age,(48-53) obesity,(54) bone mineral density,(55) rheumatoid arthritis, gout, other inflammatory arthropathies, reduced 25-hydroxyvitamin D,(53) heredity,(50) Heberden's nodes,(49-51, 56, 57) and osteoarthrosis involving other joints in the body ("systemic or generalized osteoarthrosis")(8, 49, 56-59) are risks. Unilateral elbow osteoarthrosis as a consequence of a prior, discrete occupational traumatic event (e.g., humeral or radial head fracture) is considered work-related. There are no quality studies for other occupational activities. There are some remote reports of elevated odds ratios associated with vibratory tool use.

Lateral Epicondylalgia

Lateral epicondylalgia is widely considered to have a relationship with job physical factors;(2, 33) however, most epidemiological studies are cross sectional and/or lack quantification of job physical factors.(32, 60-68) There are no robust prospective cohort studies with measured job physical factors, detailed standardized physical examinations and frequent follow-up of workers that have been reported to establish causal job physical factors. In addition, there are few epidemiological studies demonstrating moderate or strong associations. This results in a limited evidence base for purposes of either prevention or determination of work-relatedness. It is currently assumed the risks will be demonstrated to be strongest in jobs that combine high force with high repetition, particularly with high duration of exertion. Nevertheless, that relationship(s) currently remain(s) unestablished. Some cases occur after discrete traumatic events (most commonly, bumping an elbow against equipment or machinery) and are considered work-related. Unaccustomed use is also thought to be a risk, but is not well demonstrated. Psychosocial factors have been reported as significant in a few trials with evidence of low social support at work associated with lateral epicondylitis.(62) A recent clinical trial reported the most important factors determining disability were depression and ineffective coping skills.(69)

Medial Epicondylalgia

Medial epicondylalgia is theorized to be analogous to lateral epicondylalgia. However, this theory is unclear. There are no quality studies of medial epicondylalgia.(32, 63, 66, 70) By analogy, stereotypical, forceful use is believed to be a risk.

Olecranon bursitis

Olecranon bursitis is considered work-related when there is a discrete traumatic event, including falls onto or bumps against the olecranon. Development of olecranon bursitis after unaccustomed leaning on the elbow is also thought to be work-related. There are no quality studies to associate routine work activities with the development of this bursitis.

OsteoNecrosis [avascular necrosis (AVN)]

Osteonecrosis rarely affects the elbow (see Hip and Groin Disorders chapter for discussion of risks).

Pronator Syndrome

There are no quality studies of pronator syndrome. Cases are poorly understood and work-relatedness is speculative. Cases occurring secondary to fibrotic bands that are secondary to work-related trauma are considered work-related. Cases occurring due to pronator hypertrophy related to high force activities are also typically considered work-related.

Radial Neuropathies (including radial tunnel syndrome)

There are no quality epidemiological studies of radial tunnel syndrome.(71) Some cases occur due to sequalae of trauma (e.g., scar tissue), thus the mechanism of the trauma determines whether the radial nerve entrapment is occupational. Other cases are poorly understood and work-relatedness is speculative.

Ulnar Neuropathies (including condylar groove and cubital tunnel syndrome)

There are no quality epidemiological studies of ulnar neuropathies at the elbow, including either condylar groove or cubital tunnel syndrome. Unfortunately, in common practice, these disorders are frequently not distinguished, yet the risk factors for these two different neuropathies are believed to be quite different. Many use analogies to CTS, yet those analogies are largely inappropriate since the theoretical mechanisms to cause CTS are anatomically impossible at the elbow due to lack of tendons and tendon sheaths accompanying the ulnar nerve.

Condylar groove ulnar neuropathies are thought to have risks associated with the nerve as it traverses the elbow joint that include flexed elbow posture including sleep posture, arthritic disorders, joint abnormalities, ganglia, diabetes mellitus,(72) excessive alcohol consumption, repeated pressure on the condylar groove, and sequalae of discrete trauma. Cubital tunnel syndrome is thought to occur due to ulnar nerve insults distal to the elbow joint including fascial bands in the muscle, muscle hypertrophy, and sleep posture. Cubital tunnel syndrome is thought to potentially occur with sustained, repeated, stereotypical forceful use. There is a study reported of ulnar neuropathy at the elbow in association with “holding a tool in position.” However, the study follow-up was a single occasion 3 years later, thus a serial cross sectional study design, the dropout rate was 58%, and the case definition was unclear. The case definition for “cubital tunnel syndrome” included Tinel’s at the elbow; however, the Tinel’s was performed at the condylar groove and not the cubital tunnel(73) and there were no electrodiagnostic studies. The study found only one of approximately 10 occupation-related exposures associated with “cubital tunnel syndrome,” thus also potentially a chance association.(74)

Quality occupational epidemiological studies on the etiology of ulnar and radial neuropathies have not been reported, thus causation of those disorders is speculative. There are multiple theories of causation for these disorders. Olecranon bursitis can be associated with work-related trauma. This condition is thought to arise from either acute trauma to the olecranon bursa or unaccustomed pressure to the bursa.

Job Analysis

Some elbow symptoms are occupational in origin, differing by industry, job task, or disorder in question. By analogy to the hand and wrist, decisions about which jobs to analyze, and their prioritization, are thought to be of increasing importance as the proportion of affected individuals has been identified as in excess of 50% of the workforce per annum in settings of combinations of high force and high stereotypical occupational activity. In general, prioritization of job analyses in workplace settings is based on the numbers of affected individuals, reported and perceived rates of MSDs, costs and severity of the disorders, and planned job redesigns. From an occupational health care perspective, ergonomic analysis of a job may also be indicated for failure to improve in the absence of other plausible explanations. The employer’s role in accommodating activity limitations and preventing further problems through ergonomic changes may be a key factor in hastening the employee’s return to full activity, particularly among workers with a history of high job physical factors. In some cases, it may be desirable to conduct an ergonomic analysis of the activities that may be contributing to the symptoms.

Acute Trauma, incl. Fractures, Dislocations, Sprains, Crush Injuries, Compartment Syndrome, Olecranon Bursitis (related to trauma)

Job analyses may be beneficial to prevent future occurrences of these types of injuries (e.g., machine guarding, icy walkways, tool kickback). Some of these, particularly compartment syndrome and fractures should generally be analyzed for root cause and potential remediation, as these injuries are generally viewed as critical incident cases.

Biceps Strains and Ruptures

Job analyses may be of benefit to prevent future occurrences in cases involving high force exertions.

Elbow Osteoarthrosis

Job analysis is generally not indicated for most cases, although where there is potential to eliminate a hazard that precipitated an acute event (e.g., icy sidewalk, tripping hazards), it should be resolved. There have been no quality job analysis tools developed to analyze jobs for risk of elbow osteoarthrosis.

Epicondylalgia (especially lateral)

Analysis of jobs for risk of lateral epicondylalgia currently parallels that of carpal tunnel syndrome as the job evaluation methods are largely comparable if not identical in most cases and there is a lack of strong or moderate evidence the risks differ for these disorders. The sole exception, the potential for repeated pronation/supination cycles to produce lateral epicondylalgia, is an additional, theoretical ergonomic evaluation consideration. In certain cases, it may be desirable to conduct an ergonomic analysis of the activities that may be contributing to the symptoms. A broad range of ergonomic surveys and instruments is available for estimating duration of hand intensive activities, grasp repetition rates, pinch force, part or tool weights, reach distance, frequency of motion, wrist and hand postures, as well as psychological factors such as organizational relationships and job satisfaction(75) (e.g., the American Conference of Governmental Industrial Hygienists Threshold Limit Value for Hand Activity,(76) Strain Index,(77) Motion Time Measurement Analysis.) Such detailed measures may be necessary or useful for modifying activity, for redesigning the workstation, or for recommending organizational and management initiatives. These situations may call for referral to certified professional ergonomists or a human factors engineer either through the patient or the employer. Some occupational therapists, physical therapists, and other professionals also may have appropriate credentials and experiences to accomplish these evaluations. Evaluation of jobs for risk of medial epicondylalgia is currently believed to be essentially the same as for lateral epicondylalgia as quality evidence for medial epicondylalgia is lacking.

Non-Specific Elbow Pain

Job analysis is difficult for many of these conditions, particularly as the discrete entity to be evaluated and job analysis methods are unclear. However, job analyses may also be revealing particularly when there is a high exposure situation (i.e., high force or combinations of high force and other ergonomic risk factors). This may be especially indicated where other cases of MSDs are present in the workforce and may help with the treatment plan.

Osteonecrosis

Job analysis is generally not indicated for most cases, although where there are exposures such as decompression, job analysis to evaluate decompression protocols may be helpful.

Pronator Syndrome

Job analysis methods are unclear. Cases occurring due to pronator hypertrophy related to high force activities may theoretically benefit from job analyses.

Radial neuropathies (including radial tunnel syndrome)

As physical risk factors are undefined, job analyses are unhelpful.

Ulnar Nerve Entrapment at the Elbow (including Condylar Groove and Cubital Tunnel Syndrome)

Cases of ulnar neuropathy in the condylar groove may benefit from job analyses to identify tasks involving pressure on the condylar groove that include leaning on the nerve or avoiding opportunities to bump the nerve. Sustained or repeated hyperflexion of the elbow beyond 90° also may be identified and ameliorated. Cases of ulnar neuropathy in the cubital tunnel are thought to potentially be related to sustained or repeated high force activities or hyperflexion of the elbow. Avoidance of high force activities may be of assistance. Avoidance of hyperflexion is thought to also be helpful.

Ergonomic Interventions for Elbow Musculoskeletal Disorders with an Occupational Basis

In order to facilitate recovery and prevent recurrence of elbow musculoskeletal disorders, the physician may recommend work and activity modifications or ergonomic redesign of the workplace.(78) The employer's role in accommodating activity limitations and preventing further problems through ergonomic changes is crucial in hastening the employee's return to full activity. In some cases it may be desirable to conduct an ergonomic analysis of the activities that may be contributing to the symptoms. A broad range of ergonomic surveys and instruments is available for estimating duration of hand intensive activities, grasp repetition rates, pinch force, part or tool weights, reach distance, frequency of motion, and wrist and hand postures, as well as psychological factors such as organizational relationships and job satisfaction. Such detailed measures may be necessary or useful for modifying activity, redesigning the workstation, or recommending organizational and management relief. Such situations may require a therapy plan of care to include an ergonomic analysis or call for referral to certified professional ergonomists, a human factors engineer or other professionals with the capabilities to perform these analyses.

1. *Recommendation: Ergonomic Interventions for Epicondylalgia*
   In settings with combinations of risk factors (e.g., high force combined with high repetition), ergonomic interventions are recommended to reduce risk factors for epicondylalgia.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: Ergonomic Interventions for Ulnar Neuropathies at the Elbow*
   In settings with sustained or repeated hyperflexion of the elbow (> 90 degrees), ergonomic interventions are recommended to reduce elbow flexion.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

3. *Recommendation: Ergonomics Training in Moderate- or High-risk Manufacturing Settings*
   Ergonomics training is recommended in moderate- or high-risk manufacturing settings.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendations

There are no quality studies of ergonomic interventions for epicondylalgia, although ergonomics interventions have been attempted in numerous occupational settings.(79) However, a few RCTs have explored keyboard workstations(80-83) (see Hand, Wrist, and Forearm Disorders chapter). There also have been quality studies reported regarding participatory ergonomics programs; however, those are mainly reports of patients with spine disorders in programs whose purpose is return to work(84) (see Low Back Disorders chapter). Despite the lack of quality evidence, reductions in job physical factors, particularly high force, are thought to be beneficial(85) (see Work-Relatedness). There also are experimental studies of different equipment;(86) however, reports of linkage with MSDs are lacking.

There are no quality studies of ergonomic interventions for epicondylalgia or other elbow MSDs in physically demanding occupations. Interventions which reduce forceful, repeated pinching or alleviating localized compression by sharp objects may be theoretically helpful.(87-102) Quality evidence is not available for effectiveness of ergonomic interventions on MSD injury rates in typical manufacturing settings. However, given available evidence of risk factors, interventions are recommended where there are combinations of risk factors; particularly combined high force and high repetition (see Work-Relatedness). Management/supervisor and labor/employee support are often necessary for optimal success of these programs. While quality evidence is lacking for the use of ergonomics training, it is thought to be beneficial in high-risk settings and is recommended.

Evidence for the Use of Ergonomic Interventions
There are no quality studies evaluating the use of ergonomic interventions.

Return-to-Work Programs

Return-to-work programs have not been well studied among patients with elbow disorders (see Chronic Pain chapter). Several studies suggest that job physical demands, lack of job accommodation, and psychosocial conditions are the most important factors in predicting work disability.(103-105) In the U.S., these programs are typically informal, involve early, if not immediate, interventions involving the patient, healthcare provider, workplace supervisor and insurer to return the worker to productive work. Some involve physical or occupational therapists, particularly if the employer has difficulty identifying modified duty positions, although many occupational physicians also perform those services. More formalized evaluations are sometimes performed for patients with chronic lost-time injuries. Return-to-work programs in Europe typically involve only patients with chronic pain with long-standing lost-time. They have typically involved a team of providers, formal meetings and return to work activities.

1. *Recommendation: Return-to-Work Programs for Treatment of Subacute or Chronic Elbow MSDs*
   Return-to-work programs are recommended for treatment of subacute or chronic elbow MSDs, particularly patients with significant lost time.

   Strength of Evidence **– Recommended, Insufficient Evidence (I)**

2. *Recommendation: Return-to-Work Programs for Treatment of Acute, Severe Elbow MSDs*
   There is no recommendation for or against return-to-work programs for acute, severe elbow MSDs.

   Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendations
There are no quality studies that review the types of return-to work programs typically found in the U.S. There is one quality study from Spain;(106) however, most patients had spine disorders and the program otherwise may have limited applicability due to longstanding, early active management of these issues in the U.S. 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 elbow MSDs with lost time, and may be helpful for proactive emphases on functional recovery. There is no recommendation for those with acute, severe elbow MSDs, although early return to work is thought to improve earlier, functional recovery.

Evidence for the Use of Return-to-Work Programs
There is 1 moderate-quality RCT incorporated into this analysis(106) (see Low Back Disorders and Chronic Pain chapters for additional studies).

Work Activities

Table 6 provides consensus recommendations on activity modification and duration of absence from work. These guidelines are intended for patients without comorbidity or complicating factors. The recommendations are targets to provide a guide from the perspective of physiologic recovery. Key factors to consider in disability duration are age and job activities. By communicating with patients and employers, physicians can make it clear that:

- Limit forceful wrist movement that involve extrinsic muscles attached at the elbow.
- Forceful repetitive grasping may increase elbow symptoms.
- Sustained or repeated hyperflexion of the elbow may increase ulnar nerve symptoms.
- Modified work and workplace activity guides may allow for recovery or time to (re)build activity tolerance through exercise.

Significant reductions in unnecessary lost work time can occur when the patient, physician, and employer work together to develop and apply modified work activities.(107-111)

Acute Trauma, including Fractures, Dislocations, Sprains, Crush Injuries, Compartment Syndrome, Olecranon Bursitis (related to trauma)

Fractures require work limitations to avoid use of the fractured arm. Functional restrictions of the affected extremity are limited by an immobilization technique. Activities should be modified to allow for splinting and immobilization of the forearm. Return to work will likely be influenced by the patient and provider's subjective assessment of disability and perception of job difficulty. It may be helpful to refer the patient to an occupational therapist to address the appropriate activity modification, compensatory strategies, adaptive equipment, and environmental modification throughout the period of the patient's recovery and rehabilitation. The other injuries may or may not require work limitations depending on severity of the injury and the task demands. However, moderate to severe sprains and dislocations likely necessitate splinting and limitations.

Biceps Strains and Tears/Ruptures

Biceps strains may not require work limitations if mild and the patient has the ability to avoid the high force activity. However, the more forceful the work and more significant the symptoms, the more likely work limitations will be needed for biceps strains. Biceps tears/ruptures require work limitations during the recovery phase that typically include no use for a period of at least a couple weeks followed by graded increase in activities.

Epicondylalgia (Lateral or Medial)

Some physicians place work restrictions on patients with epicondylalgia while others do not. There is no quality evidence to suggest that restrictions are required, yet there are widely believed to be some activities that may prolong or perpetuate symptoms of lateral epicondylalgia. Careful advice regarding maximizing activities within the limits of symptoms is believed to be important. Activities that increase stress on the wrist's extensor mechanism, which originates at the elbow, tend to aggravate symptoms. Consequently, consideration may be given to restrictions on forceful use, lifting, and repetitive flexion or extension following the onset of epicondylalgia. Workstation modifications to reduce the force on the elbow are believed to be important in resolving the problem in cases where the occupational tasks materially contribute. Understanding the worksite and the employer's willingness to and the feasibility of modifying the workstation may be important to maintain the employee at work and/or minimize disability time.

Recommendation: Work Restrictions for Treatment of Epicondylalgia
For patients with medial or lateral epicondylalgia, it is recommended that their work be restricted to those tasks that do not involve high-force stereotypical hand gripping or pinching or the use of high-amplitude vibrating hand-held tools.

Indications – Select patients with combined forceful and repeated stereotypical use of the hands.

Indications for Discontinuation – Resolution, lack of improvement, or desire of the patient to remove limitations.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality studies evaluating workplace restrictions for treatment of epicondylalgia. One trial included "rest" as a treatment arm and failed to find efficacy of rest.(112) Thus, whether patients improve more quickly with activity limitations has not been proven. There are trials that have included ergonomic advice as a co-intervention, although the advice is usually simply avoiding aggravating activities.(12) However, based on available evidence associating combined forceful and repeated, stereotypical use of the hands with epicondylalgia, work restrictions are recommended to treat select patients. These types of jobs involve a minority of patients with epicondylalgia. Restrictions are not invasive, likely have few adverse effects, and may be moderate to high cost depending on length of time they are in place.

Evidence for the Use of Work Restrictions for Epicondylalgia
There is 1 moderate-quality RCT incorporated into this analysis.

Elbow Osteoarthrosis

Elbow osteoarthrosis generally requires no work limitations. When the disease progresses to moderate or severe, work limitations may be required due to the impairment and/or pain.

Non-Specific Elbow Pain

Job limitations are generally thought to be not necessary for most cases of non-specific pain as they tend to be self-limited. However, in cases where symptoms persist and/or in settings with combined high force and high repetition, workplace limitations may be tried to assess if there is a significant impact of job physical factors.

Osteonecrosis

There is no evidence that work restrictions are helpful, yet as the condition often progresses, patients typically incur increasing degrees of disability with a progressive need for work limitations. Advanced cases generally require temporary removal from work and surgery, with return to work post-operatively. Post-operative limitations are generally based on a combination of the clinical results (i.e., severity of pain and symptoms) and work demands. Patients with light to medium work may require no limitations, while those with medium to heavy work, particularly with post-operative pain, may require significant limitations.

Pronator Syndrome

Job analysis methods are unclear. Cases occurring due to pronator hypertrophy related to high force activities may theoretically benefit from job analyses.

Radial Neuropathies (including Radial Tunnel Syndrome)

As physical risk factors are undefined, job analyses are unhelpful.

Ulnar Nerve Entrapment at the Elbow (including Condylar Groove and Cubital Tunnel Syndrome)

Job modifications are thought to be needed in some cases to facilitate recovery.

Recommendation: Modification of Work Activities for Ulnar Neuropathies at the Elbow
Removal from job tasks with repeated or sustained elbow hyperflexion is recommended for ulnar neuropathies at the elbow.

Indications – Patients with sustained or repeated flexion of the elbow beyond 90 degrees.

Indications for Discontinuation – Resolution, lack of improvement, or desire of the patient to remove limitations.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality studies evaluating the modification of work activities for ulnar neuropathies at the elbow. However, where occupational factors are significant, especially for patients with hyperflexion of the elbow, a trial of removal from that type of work may be indicated.

Special Studies, Diagnostic and Treatment Considerations

Diagnostic Criteria and Differential Diagnosis

The criteria presented in Table 5 follow the clinical thought process, 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). Elbow disorders, as described by the patient, can sometimes be consistent with radiating symptoms from the neck or shoulder, and the examining physician's diagnostic acumen is important in determining the source. For example, mid-upper-arm pain on arm elevation is most likely related to a problem originating in the shoulder area, not the elbow, although patients may have pain in both areas. It is important to note that lateral elbow pain can be due to cervical disc disease (C6), radial nerve entrapment (including radial tunnel syndrome), synovitis due to degeneration, or true epicondylitis (enthesitis).(113) A complaint of tingling and/or numbness in the fourth and fifth fingers is usually due to ulnar nerve impingement at the elbow, C8 cervical radiculopathy, or impingement of the ulnar nerve at the wrist. Thoracic outlet syndrome can be considered, although that condition is generally believed to be quite uncommon (see Shoulder Disorders chapter). For the differential diagnosis of lateral epicondylalgia, C6 radiculopathy is believed to be the most common alternate diagnosis and not infrequently presents with lateral elbow pain and paresthesias in the thumb. The differential diagnosis of medial epicondylalgia similarly includes C8 radiculopathy presenting as medial elbow pain and paresthesias in the fourth and fifth digits.

Medial collateral ligament problems may also present with medial elbow pain. Concomitant existence of medial epicondylalgia with ulnar neuropathy at the elbow frequently occurs. In cases of complaints that cannot be classified as a specific pathophysiological condition, a diagnosis of non-specific pain should be used. This is far preferable to specific labeling, which may not be accurate. Non-specific or regional pain will more frequently be the most appropriate diagnosis if there are no specific physical findings. The criteria presented in Table 5 below list the probable diagnosis or injury, potential mechanism(s) of illness or injury, symptoms, signs, and appropriate tests and results to consider in assessment and treatment.

Table 5. Diagnostic Criteria for Non-Red-Flag Conditions

Probable Diagnosis or Injury	Mechanism	Symptoms	Signs	Test and Results
Contusion	Direct blow / Fall	Local pain	Range of motion usually normal / Soft tissue swelling / Ecchymosis	None
Nondisplaced Radial Head Fracture	Fall onto outstretched hand / Fall onto lateral elbow	Lateral elbow pain / Pain on pronation and supination of forearm	Maximal tenderness over radial head / Reduced elbow extension when compared with unaffected side	Radiograph evidence of fracture or effusion
Lateral Epicondylalgia/ Epicondylitis/ Tendinosis	Possibly related to forceful use of elbow or wrist, repetition and postural factors / Some cases related to acute trauma	Pain in lateral elbow. / [Absence of tingling/numbness.] / [Absence of neck pain or stiffness.]	Tenderness over epicondyle and 2-3 centimeters distal to it over the extensor carpi radialis brevis and extensor digitorum tendons / Pain in lateral elbow with resisted extension of wrist or middle finger / Pain in the lateral elbow with forceful grasp / Normal elbow range of motion / Diffuse lateral elbow pain with repeated wrist dorsiflexion	Positive resistance test results: lateral epicondylar area pain with resisted extension of the wrist, middle finger, index finger, and/or supination
Medial Epicondylalgia/ Epicondylitis/ Tendinosis	Etiology is unknown / Theorized to parallel that of lateral epicondylalgia	Pain in medial elbow / [Absence of tingling/numbness in most cases unless accompanied by ulnar neuropathy] / [Absence of neck pain or stiffness]	Tenderness over medial epicondyle or 2 to 3 centimeters distal to it / Pain in medial elbow with resisted wrist or phalangeal flexion / Normal elbow range of motion	Positive resistance test results: pain with resisted flexion of the wrist, fingers, and pronation

Probable Diagnosis or Injury	Mechanism	Symptoms	Signs	Test and Results
Ulnar Nerve Entrapment (including Cubital Tunnel Syndrome)	Two main categories involving cubital tunnel and condylar groove / Etiologies are unclear; there are no quality epidemiological studies / Theorized mechanisms include hyperflexion of the elbow or prolonged leaning on the elbows for condylar groove segment neuropathies	Paresthesias in the ring and 5th digits; generally spares dorsal surfaces / Pain may or may not be present	Paresthesias in ring and small fingers on 60-second elbow flexion test / Subluxation of the ulnar nerve in the condylar groove sometimes present / Weakness/atrophy of ulnar hand intrinsics and interosseous muscles (unusual/late) / Hoffman-Tinel's test over the condylar groove segment is thought to not be helpful as it is often abnormal in the absence of symptoms.	Nerve conduction study with above vs. below elbow conduction assessment / "Inching technique" may be helpful to document a focal decrement in a specific ulnar nerve location although it has not been rigorously examined regarding if it affects outcomes. A problem is most typically in condylar groove or cubital tunnel segments of the nerve. / Abnormalities on EMG are later findings typical of more advanced cases.
Radial Nerve Entrapment (including Radial Tunnel Syndrome)	Etiology is unknown; there are no quality epidemiological studies.	Studies of the clinical presentation of this disorder are not well performed. Thought to involve aching pain in extensor/supinator area of forearm.	Physical exam findings are not well characterized for this disorder. / Pain on stressing extended middle finger / Maximum tenderness 4 finger breadths anterior and inferior to lateral epicondyle / Utility of Hoffman-Tinel's test undetermined	High-quality studies do not exist. Some believe nerve conduction velocity decrements are uniformly present and others believe abnormal nerve conduction findings are variably present.
Olecranon Bursitis (noninfectious)	Prolonged leaning on elbow/chronic pressure / Acute trauma / Chronic pressure	Swelling of bursa / Pain in bursa generally absent or minor	Effusion/mass effect in bursa / Tenderness over bursa generally not present or minor / Tenderness more likely with complications of inflammatory arthropathy	Monosodium urate or uric acid crystals if gout / Calcium pyrophosphate crystals if pseudogout

Probable Diagnosis or Injury	Mechanism	Symptoms	Signs	Test and Results
Olecranon Bursitis (infectious)	Trauma with non-intact dermis / Introduced infections from injection(s) / Systemic infection	Progressive painful swelling of bursa / Systemic signs of infection	Erythema, warmth and/or surrounding cellulitis / Marked tenderness over bursa	Purulent tap, positive gram-stain results, positive culture results / Portal of entry for infection
Biceps Tendinosis	Forceful flexion, particularly near maximal or repeated high force / Unaccustomed forceful use	Pain in anterior elbow joint or antecubital fossa	Tenderness on palpation of biceps myotendinous junction	Pain in the biceps insertion area with resisted elbow flexion
Pronator Syndrome	Etiology unclear	Pain in proximal fore-arm with paraesthesias in median nerve distribution of hand	May be tender over pronator muscle	Resisted pronation augments symptoms
Non-specific Elbow Pain	Unknown	None	None	None

For most patients presenting with non-traumatic elbow disorders, special studies are not needed during the first 4 weeks. Most patients improve quickly, provided red flag conditions are ruled out. Also, of note, a number of patients with elbow symptoms will have associated disease such as diabetes mellitus, hypothyroidism, renal disease, and one or more of the arthritides which are often heretofore undiagnosed. When medical history and/or physical examination findings indicate or other risk factors are present, testing for these or other comorbid condition(s) is recommended.

Table 6. Guidelines for Modification of Work Activities and Disability Duration*

Disorder	Activity Modifications and Accommodation	Recommended Target for Disability Duration**	
		With Modified Duty* **	**Without Modified Duty**
Biceps Strain	Modification of activities involving the muscle-tendon unit, i.e., those that cause significant symptoms. Workstation assessment to insure optimal ergonomics, as appropriate.	0-3 days	7-14 days
Biceps Rupture	One-handed work while recovering from surgery for approximately initial 2 weeks. Graded increase in activity over approximately 6-12 weeks.	3-7 days	9-12months‡
Epicondylalgia (both Lateral and Medial)	Avoid activities that cause significant symptoms or require excessive force on repeated basis.	0 days	3-14 days€
Elbow Sprain	Avoid activities that cause significant symptoms or apply excessive force of elbow	0-3 days	7-14 days
Olecranon Bursitis (Non-infectious)	Avoid leaning on or bumping elbow. Consider elbow/olecranon soft padding.	0 days	0 days
Pronator Syndrome	None known to be beneficial. Consider avoiding repeated high force use.	0 days	0-14 days†
Radial Neuropathies at the Elbow	None known to be beneficial	0 days	0-14 days†

Disorder	Activity Modifications and Accommodation	Recommended Target for Disability Duration**	
		With Modified Duty***	Without Modified Duty
Ulnar Neuropathy at the Elbow	Consider workstation adjustments to avoid hyperflexion. If true cubital tunnel syndrome, consider avoiding repeated high force use.	0 days	0-14 days†
Elbow Fractures	No use of fractured elbow	0-3 days	Depending on treatment (i.e., cast vs. screw), generally up to 8 weeks if unable to accommodate and forceful use of hand is required. May be longer in cases of delayed healing.

*These are general guidelines based on consensus or population sources and are never meant to be applied to an individual case without consideration of workplace factors, concurrent disease or other social or medical factors that can affect recovery.
**These parameters for disability duration are consensus optimal targets as determined by a panel of ACOEM members in 1996, reaffirmed by a panel in 2002 and 2010. In most cases, persons with one non-severe extremity injury can return to modified duty immediately. Additional limitations of the frequency or pressure of keyboard use or pinch grasp may be warranted.
***If the workplace has the ability to accommodate one handed use, then there is no time loss that is generally justifiable. Situations of severe injuries with considerable pain may be limited exceptions.

†Many of these cases require no lost time.
‡These cases are particularly challenging and longer periods of time loss are not unusual, particularly where there is no accommodation for limitations.
€Severe cases may take 30 days or longer for disability duration, although full recovery may take several weeks to months for some patients.

Diagnostic Testing and Other Testing

Antibodies

There are numerous antibodies that 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 elbow.(114-118)

1. *Recommendation*: *Antibodies for Diagnosing Elbow Pain with Suspicion of Chronic or Recurrent Rheumatological Disorder*
   Antibody levels are recommended to evaluate and diagnose patients with elbow pain who have reasonable suspicion of rheumatological disorder.

   Indications – Patients with elbow pain with suspicion of rheumatological disorder.

   Strength of Evidence **– Recommended, Insufficient Evidence (I)**

2. *Recommendation*: *Antibodies to Confirm Specific Disorders*
   Antibody levels are strongly recommended as a screen to confirm specific disorders (e.g., rheumatoid arthritis).

   Indications – Patients with elbow pain and a presumptive diagnosis of a rheumatological disorder.

   Strength of Evidence – **Strongly Recommended, Evidence (A)**

Rationale for Recommendations
Elevated antibody levels are highly useful for confirmation of clinical impressions of rheumatic diseases. However, routine use of these tests in patients with elbow pain – especially as wide-ranging, non-focused test batteries – are likely to result in inaccurate diagnoses due to false positives and low pre-test probabilities and are not recommended. 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.

Elbow Arthroscopy

Arthroscopy of the elbow has been used for diagnosis and treatment of some patients with elbow disorders,(119-121) (Hsu 09; Dodson 09; Rahusen 11) however, indications for either diagnostic or therapeutic procedures are not well defined with quality studies.

1. *Recommendation*: *Elbow Arthroscopy for Diagnosing Elbow Pain with Suspicion of Intraarticular Body and Other Subacute or Chronic Mechanical Symptoms*
   Arthroscopy is recommended to evaluate and diagnose patients with elbow pain that have suspicion of intraarticular body, and other subacute or chronic mechanical symptoms.

   Indications – Patients with elbow pain with suspicion of intraarticular body, or other subacute or chronic mechanical symptoms.

   Strength of Evidence **– Recommended, Insufficient Evidence (I)**

2. *Recommendation*: *Arthroscopy for Diagnosing Acute Elbow Pain*
   Arthroscopy for diagnosing acute elbow pain is not recommended.

   Strength of Evidence **– Not Recommended, Insufficient Evidence (I)**

3. *Recommendation*: *Elbow Arthroscopy for Diagnosis or Treatment of Osteoarthrosis without Mechanical Symptoms and in the Absence of Remediable Mechanical Defect such as Symptomatic Loose Body*
   Arthroscopy is not recommended for diagnosis or treatment in acute, subacute, or chronic patients with osteoarthrosis in the absence of a remediable mechanical defect such as symptomatic loose body.

   Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

4. *Recommendation*: *Elbow Arthroscopy with Chondroplasty for Osteoarthrosis*
   Arthroscopy with chondroplasty is not recommended for treatment of osteoarthrosis.

   Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendations
There are no quality studies of arthroscopy; however, arthroscopy has been widely used to diagnose and treat numerous joint abnormalities. Successful treatments have particularly included meniscal tears, removal of loose bodies and rotator cuff repairs (see respective chapters). By analogy, arthroscopy allows successful diagnosis and treatment of intraarticular elbow pathology. By analogy with the knee joint where quality evidence has demonstrated a lack of efficacy of chondroplasty,(122) chondroplasty of the elbow joint is not recommended. Arthroplasty is invasive, has some adverse effects and is costly. However, it is indicated particularly in those patients with persistent mechanical elbow joint symptoms.

Bone Scans

Bone scans involve intravenous administration of a radioactive tracer medication that is preferentially concentrated in areas of metabolic activity in bone.(123, 124) The radioactivity is then detected by a large sensor, and converted into images of the skeleton. There are many causes for abnormal radioactive uptake, including metastases, infection, inflammatory arthropathies, fracture or other significant bone trauma. 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.(125-128)

1. *Recommendation: Bone Scanning for Select Use in Acute, Subacute or Chronic Elbow Pain*
   Bone scanning is recommended for select use in acute, subacute or chronic elbow pain to assist in the diagnosis of osteonecrosis, neoplasms and other conditions with increased polyosthotic bone metabolism, particularly where there is more than one joint to be evaluated.

   Indications – Patients with elbow pain with suspicion of osteonecrosis, Paget's disease, neoplasm or other increased polyosthotic bone metabolism.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: Routine Use of Bone Scanning for Routine Elbow Joint Evaluations*
   Bone scanning is not recommended for routine use in elbow joint evaluations.

   Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendations
Bone scanning may be a helpful diagnostic test to evaluate suspected metastases, primary bone tumors, infected bone (osteomyelitis), inflammatory arthropathies, and trauma (e.g., occult fractures). It may be helpful in those with suspected, early AVN but without x-ray changes. In those where the diagnosis is felt to be secure, there is not an 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. It is generally thought to be inferior to MRI.

Computerized Tomography (CT)

Computerized tomography remains an important imaging procedure, particularly for bony anatomy, whereas MRI is superior for soft tissue abnormalities.(129-131) (Bahrs 09; Ohashi 09; Haapamaki 05) CT may be useful for elbow joint abnormalities where advanced imaging of the bones is required. CT may be helpful for evaluation of AVN and following traumatic dislocations or arthroplasty-associated recurrent dislocations. CT also may be useful to evaluate patients with contraindications for MRI (most typically an implanted metallic-ferrous device).(130)

1. *Recommendation: Routine CT for Evaluating Acute, Subacute, Chronic Elbow Pain*
   Routine CT is not recommended for evaluation of acute, subacute, or chronic elbow pain.

   Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

2. *Recommendation: CT for Evaluating Patients with Osteonecrosis (AVN)*
   CT is recommended for evaluating patients with osteonecrosis or following traumatic dislocations or arthroplasty-associated recurrent dislocations, or for patients who need advanced imaging but have contraindications for MRI.

   Indications – Patients with elbow pain from osteonecrosis with suspicion of subchondral fracture(s), increased polyosthotic bone metabolism. As MRI is generally preferable, patients should have a contraindication for MRI. Patients who have traumatic elbow dislocations, particularly if capitular or trochlear fracture fragments are sought.

   Strength of Evidence **– Recommended, Insufficient Evidence (I)**

3. *Recommendation: Helical CT for Select Acute, Subacute, or Chronic Elbow Pain*
   Helical CT is recommended for select patients with acute, subacute, or chronic elbow pain in whom advanced imaging of bony structures is thought to be potentially helpful, and for patients with a need for advanced imaging but who have contraindications for MRI.

   Indications – Patients with acute, subacute, or chronic elbow pain who need advanced bony structure imaging. Patients needing advanced imaging, but with contraindications for MRI (e.g., implanted hardware) are also candidates.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendations
Computerized tomography is considered superior to MRI for imaging of most elbow abnormalities where advanced imaging of calcified structures is required. A contrast CT study is minimally invasive, has few if any, adverse effects but is costly. It is recommended for select use. Helical CT scan has been thought to be superior to MRI for evaluating subchondral fractures; however, a definitive study has not been reported.(132)

C-Reactive Protein, Erythrocyte Sedimentation Rate, and Other Non-Specific Inflammatory Markers

There are many markers of inflammation that may be measured serologically. These include C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), ferritin, and an elevated total protein-albumin gap.(133-136)

Recommendation: Non-Specific Inflammatory Markers for Screening for Inflammatory Disorders in Patients with Subacute or Chronic Elbow Pain
Erythrocyte sedimentation rate and other inflammatory markers are recommended for screening for inflammatory disorders or prosthetic sepsis with reasonable suspicion of inflammatory disorder in patients with subacute or chronic elbow pain.

Indications – Patients with elbow pain with suspicion of rheumatological disorder.

Strength of Evidence **– Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
Erythrocyte sedimentation rate is the most commonly used systemic marker for non-specific inflammation and is elevated in numerous inflammatory conditions including rheumatological disorders, as well as with infectious diseases. C-reactive protein is a marker of systemic inflammation that has been associated with an increased risk of coronary artery disease. However, it is also a non-specific marker for other inflammation. Other non-specific markers of inflammation include ferritin, and an elevated protein-albumin gap, which have no known clinical roles. CRP and ESR measurements 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 elbow pain patient also has other pains without clear definition of a diagnosis or those with fibromyalgia or myofascial pain syndrome, although the 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.**

Evidence for the Use of C-Reactive Protein, Erythrocyte Sedimentation Rate, and Other Non-specific Inflammatory Markers
There are no quality studies evaluating the use of C-reactive protein, erythrocyte sedimentation rate, and other non-specific inflammatory markers for elbow pain.

Cytokines

See Chronic Pain chapter.

Electromyography and Nerve Conduction Studies (Electrodiagnostic Studies)

Electrodiagnostic (ED) studies have been used to confirm diagnostic impressions of other peripheral nerve entrapments, including all peripheral nerves in the upper extremity. They may be particularly helpful to distinguish a peripheral entrapment from cervical radiculopathy (137, 138) (see Cervical and Thoracic Spine Disorders chapter for discussion of ED studies for evaluation of spine-related disorders that may present as elbow pain). NCS and EMG may be normal, particularly in some mild cases of neuropathies. If ED studies are negative, tests may be repeated later in the course of treatment if symptoms persist. It is also important to recognize that ED studies are abnormal in a considerable proportion of patients who are without symptoms. (139) Thus, ED studies in a patient with a low pre-test probability of peripheral nerve entrapment may result in inappropriate diagnosis. (140, 141)

1. *Recommendation: Electromyography for Diagnosing Subacute or Chronic Peripheral Nerve Entrapments*
   Electrodiagnostic studies are recommended to assist in the diagnosis of subacute or chronic peripheral nerve entrapments, including ulnar neuropathies, radial neuropathies and median neuropathies.

   Indications – Patients with subacute or chronic paresthesias with or without pain, particularly with unclear diagnosis. In addition to segmental analysis (e.g., above- versus below-elbow conduction), patients with peripheral neuropathies in the elbow region should generally have inching technique performed to localize the entrapment which assists with clinical management.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: Electrodiagnostic Studies for Diagnosis and Pre-operative Assessment of Peripheral Nerve Entrapments*

Quality electrodiagnostic studies (see above) are recommended to assist in securing a firm diagnosis for those patients without a clear diagnosis. ED studies are also recommended as one of two methods to attempt to objectively secure a diagnosis prior to surgical release.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

3. *Recommendation: Electrodiagnostic Studies for Initial Evaluation of Patients Suspected of Having a Peripheral Nerve Entrapment*
Electrodiagnostic studies are not recommended for initial evaluation of most patients as it does not change the management of the condition.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
ED studies are the only unequivocally objective measures of nerve function.(137, 138) However, there are both false-positive and false-negative test results that demand that the physician understand the pre-test probabilities and be capable of interpreting the results and placing them in an appropriate clinical context. For example, ED studies should not be ordered in settings where the clinical history suggests a low likelihood of nerve entrapment because the probability of a false-positive test result may be well above 50%. ED studies are primarily of assistance in: 1) identifying an anatomic location of nerve conduction slowing; 2) identifying objective evidence for alternate diagnostic considerations (e.g., cervical radiculopathy); and 3) quantifying nerve function to assure the physician that an operative state such as CTS is present. A survey of 350 records of electrodiagnostic studies found only 34% compliance with the AAEM guideline (see Table 7. Summary of American Association of Electrodiagnostic Medicine (AAEM) Practice Parameter to Diagnose Ulnar Neuropathy at the Elbow).(141) ED studies are not invasive or minimally invasive (depending on whether the EMG component is required), have minimal adverse effects, and are high cost. They are recommended for evaluation of select cases to assist in confirming peripheral nerve entrapments such as pronator syndrome, ulnar neuropathies at the elbow and radial neuropathies.

Table 7. Summary of American Association of Electrodiagnostic Medicine (AAEM) Practice Parameter to Diagnose Ulnar Neuropathy at the Elbow

Practice standards (class A evidence)
Temperature monitored
Elbow position recorded
Ulnar sensory NCS
Ulnar motor NCS to ADM
Practice guidelines (class B evidence)
Elbow flexed 70-90 degrees
10-cm distance between AE and BE stimulation sites
AE-to-BE NCV of <50 m/sec
AE-to-BE NCV of >10 m/sec slower than BE-to-wrist NCV
CMAP decrease of >20% between AE and BE waveforms
CMAP configuration change between AE and BE waveforms
Practice options/advisories (class C evidence)
Ulnar motor NCS to FDI
Inching study around elbow in 1- or 2-cm increments
Comparison of AE-to-BE NCV to axilla-to-AE NCV
Ulnar motor NCS to forearm flexor muscles
Needle EMG sampling that includes FDI

NCS, nerve conduction study; ADM, abductor digiti minimi; AE, above elbow; BE, below elbow; NCV, nerve conduction velocity; CMAP, compound motor action potential; FDI, first dorsal interossei; EMG, electromyography

Thibault MW, Robinson LR, Franklin G, Fulton-Kehoe D. Use of the AAEM guidelines in electrodiagnosis of ulnar neuropathy at the elbow. *Am J Phys Med Rehabil*. 2005;84:267-73. Reprinted with permission from Wolters Kluwer Health/Lippincott, Williams & Wilkins.

Functional Capacity Evaluations

See Chronic Pain chapter.

Magnetic Resonance Imaging (MRI)

Magnetic resonance imaging (MRI) is considered the imaging test of choice for viewing soft tissues (including ligamentous injuries around the elbow). MRI is helpful for evaluating extent of biceps tendinosis and ruptures. MRI is considered the gold standard for evaluating osteonecrosis after x-rays.(142-151) (Scheiber 99; Helenius 06; Sakai 08; Jones 04; Koo 95; Coombs 94; Cherian 03; Radke 03; Brunton 06; Walton 11) However, for most elbow disorders, MRI is not used as an imaging procedure.

1. *Recommendation: MRI for Diagnosing Osteonecrosis (AVN)*
   MRI is recommended for diagnosing osteonecrosis and ligamentous elbow injuries.

   Indications – Patients with subacute or chronic elbow pain thought to be related to osteonecrosis (AVN) or ligamentous elbow injuries, particularly in whom the diagnosis is unclear or who need additional diagnostic evaluation and staging.

   Strength of Evidence **– Recommended, Insufficient Evidence (I)**

2. *Recommendation: MRI for Routine Evaluation of Acute, Subacute, Chronic Elbow Joint Pathology*
   MRI is not recommended for routine evaluation of acute, subacute, or chronic elbow joint pathology, including degenerative joint disease.

   Strength of Evidence **– Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendations

MRI has not been evaluated in quality studies for elbow pathology. However, it is likely particularly helpful for soft tissue abnormalities. There are no quality studies evaluating the use of MRI for AVN, elbow joint pathology, or osteonecrosis. There is low-quality evidence MRI may be less sensitive for detection of subchondral fractures than helical CT or plain x-rays in patients with osteonecrosis.(132) MRI is not invasive, has no adverse effects, aside from issues of claustrophobia or complications of medication, but is costly. MRI is not recommended for routine elbow imaging, but is recommended for select elbow joint pathology particularly involving concerns regarding soft tissue pathology.

Roentgenograms (X-Rays)

X-rays show bony structure and remain the initial test for evaluation of most cases of elbow pain.(152, 153) Two or three views are generally performed.(154-163) (Darracq 08; Lennon 07; Ward 92; Hawksworth 91; Frick 06; Bancroft 07; Sauser 90; Lowden 04; Shaffer 97; Spencer 07)

Recommendation: X-rays for Evaluation of Acute, Subacute, or Chronic Elbow Pain
X-rays are recommended for evaluation of acute, subacute, or chronic elbow pain.

Indications – In the absence of red flags, patients with elbow pain lasting at least a few weeks, moderate to severe, and/or limited range of motion, or to evaluate for osteomyelitis in cases of significant septic olecranon bursitis.

Frequency/Duration – Obtaining x-rays once is generally sufficient. For patients with chronic or progressive elbow pain, it may be reasonable to obtain a second set of x-rays months to years subsequently to re-evaluate the patient's condition, particularly if symptoms change.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendations

X-rays are helpful to evaluate most patients with elbow pain, both to diagnose and to assist with the differential diagnostic possibilities. There are no quality studies. X-rays are non-invasive, low to moderate cost, and have little risk of adverse effects and therefore, are recommended.

Evidence for the Use of X-rays

There are no quality studies evaluating the use of x-rays for elbow pain.

Single Proton Emission Computed Tomography (SPECT) And Positron Emission Tomography (PET)

Single proton emission computed tomography (SPECT) is a 3-dimensional imaging technique in which radionucleotide tracers that release gamma radiation are used to create multiplanar re-formations. Positron emission tomography (PET) is another major technique that investigates functional and, to a lesser degree, anatomical details within the brain, but uses positron-emitting radionucleotides.

Recommendation: SPECT or PET for Diagnosing Acute, Subacute, or Chronic Elbow Pain
SPECT and PET are not recommended for diagnosing acute, subacute, or chronic elbow pain.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
SPECT or PET scanning of the brain may be useful to assess the status of cerebrovascular perfusion, tumors, and neurodegenerative conditions, but aside from providing information for research, these scans have not been shown to be useful in influencing the management of patients with chronic pain states, including chronic elbow pain. There is no quality evidence to support the use of these scans to evaluate patients with elbow pain. PET scanning is expensive and SPECT scanning moderately so. Both are minimally invasive. SPECT scanning may be useful in detecting inflammatory disease in the spine or other areas that might not be amenable to evaluation by other studies.

Evidence for the Use of SPECT or PET
There are no quality studies of SPECT or PET relevant to their use in the management of elbow pain.

Ultrasound

Diagnostic ultrasound has been used to evaluate the elbow joint, especially for epicondylalgia.(164)

Recommendation: Diagnostic Ultrasound for Other Elbow Disorders, including Osteonecrosis, Osteoarthrosis, Dysplasia and Fractures
There is no recommendation for or against the use of diagnostic ultrasound for the evaluation and diagnosis of other elbow disorders, including osteonecrosis, osteoarthrosis, dysplasia, and fractures.

Strength of Evidence **– No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendation
Ultrasound has been found to be helpful evaluating tendinopathies, including tendon ruptures. There is no clear indication for use of ultrasound for evaluation of osteoarthrosis and other disorders. Ultrasound is not invasive, has no adverse effects and is moderately costly. It is recommended for disorders with soft tissue pathology.

Evidence for the Use of Diagnostic Ultrasound
There are no quality studies evaluating the use of diagnostic ultrasound.

Initial Care

Initial treatment should generally be guided by implementing the strongest evidence-based recommendations that are considered 1st-line interventions. Exceptions include treatments that are accepted as best practices, but have not been subjected to RCTs or crossover trials (e.g., antibiotics for diabetics with "dirty" lacerations). Careful consideration of the indications and limitations described in the full text for each recommendation is critical to understanding the best application for each intervention. If treatment response is inadequate (i.e., if symptoms and activity limitations continue), 2nd- and 3rd-line recommendations may be considered.(165) Physicians should consider the possibilities of diagnosed and previously undiagnosed medical diseases such as diabetes mellitus, hypothyroidism, or various arthritides.

Comfort is often a patient's primary concern. Nonprescription analgesics will provide sufficient pain relief for most patients with acute or subacute elbow symptoms. If the patient's response to treatment is inadequate (i.e., symptoms and activity limitations continue), pharmaceuticals, orthotics, or physical methods can be prescribed. Co-morbid conditions, adverse effects, cost, and provider and patient preferences should be considerations in guiding the choice of recommendations.

For treatments of uncertain effectiveness that are free of undue risk and individual and aggregate cost, a therapeutic trial may be appropriate if adverse effects and effectiveness are carefully followed. The effectiveness of such a trial should be measured by objective findings appropriate for the patient and the intervention, and should be documented accordingly. The trial should be promptly discontinued if it does not result in subjective or functional improvement. Part of the initial treatment plan for all disorders should include patient education. For most diagnoses this is critical to successful treatment.

Recommendation: Education for Elbow Disorders
Education is recommended for patients with elbow disorders.

Frequency – 1 or 2 appointments for educational purposes. Additional appointments may be needed if education is combined with occupational or physical therapy treatments. Follow-up educational visit(s) for more severe disorders as part of a progression towards normal functional use is sometimes helpful.

Strength of Evidence **– Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality studies specifically evaluating efficacy of patient education for utility or necessity in treatment of elbow disorders. Yet, for many disorders (e.g., relationship between elbow hyperflexion and ulnar neuropathies, cast management) education appears essential. Some providers accomplish this in the course of extended patient visits, while others routinely refer patients to an occupational or physical therapist for education. Regardless of the approach, a few appointments for educational purposes are recommended for select 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. In addition, education is low cost and this is recommended.

Follow-up Visits

Patients with potentially work-related elbow symptoms should generally have a follow-up visit approximately every 3 (severe disorders) to 7 days (typical disorder severity) to monitor medication use and/or a physical or occupational therapist visit for counseling regarding contributing physical factor avoidance (e.g., reducing force, avoiding static positions), sleep posture, and other concerns. More frequent follow-up is usually required for patients who are not working. Education is recommended to include answering questions and making sessions interactive so that the patient is involved in his or her recovery including identifying potential barriers to recovery and return to normal function and work. More specific guidance for follow-up visits may be included in the discussion of each disorder topic.

Contusions

A contusion is an injury of a part without a break in the skin and with a subcutaneous hemorrhage. It is an acute injury with bruising.(30)

1. *Recommendation: NSAIDs, Acetaminophen, Ice, Compression, and Range-of-Motion Exercises for Contusions*
   NSAIDs, acetaminophen, ice, compression, and range-of-motion exercises are recommended for elbow contusions.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: Immobilization for Contusions*
   Immobilization is not recommended for elbow contusions.

   Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality studies for any of these interventions. Medical management of contusions is recommended to be directed at maintaining normal elbow function. With significant contusion-related injury, there is a risk of deep tissue involvement, potentially leading to scarring and limitation of motion. Accordingly, treatment should include anti-inflammatory medications with avoidance of immobilization except as necessitated by other injuries. Anti-

inflammatory medications serve as an analgesic in the doses that are used for contusions. Early mobilization should also be encouraged to prevent impairment and disability and can be best accomplished through instruction in the initial clinical visit. Medical management can be summarized as protection, rest, ice, compression, elevation, and range-of-motion exercises. Range-of-motion exercises should primarily involve the elbow, but may also include the shoulder and wrist, particularly if a sling is prescribed. They are all thought to be helpful, are not invasive, have low adverse effects especially for short-term use and are low cost and thus are recommended.

Evidence for the Treatment of Contusions
There are no quality trials evaluating the use of NSAIDs, acetaminophen, ice, compression, range of motion exercises, and avoidance of immobilization for elbow contusions.

Epicondylalgia

Lateral epicondylalgia (lateral epicondylitis) causes soreness, or pain on the outside (lateral) side of the upper arm near the elbow. There may be a partial tear of the tendon fibers, which connect muscle to bone, at or near their point of origin on the outside of the elbow. However, the mechanism of injury and pathogenesis is controversial and conflicting with considerable evidence of underlying chronic degenerative conditions.(9, 18, 19) Medial epicondylitis is substantially less common, but is theorized to be analogous to lateral epicondylalgia but affected the muscle-tendon units originating at the medial elbow. As there is almost no quality literature on medial epicondylalgia (see evidence table for the few studies), treatment of that condition is by analogy to lateral epicondylalgia and should be considered “Insufficient Evidence” recommendations.

Lateral Epicondylalgia (Lateral Epicondylitis, Tennis Elbow)

Diagnostic Criteria

Lateral epicondylalgia is diagnosed based on a combination of lateral elbow pain plus tenderness to palpation over the lateral epicondyle or tenderness within a couple centimeters distal to the epicondyle. Whether a resisted maneuver, such as resisted wrist or resisted middle finger extension, should be required appears questionable, as it appears to considerably reduce sensitivity with the numbers of cases decreased by approximately 50%.(45) Patients should not have other potential explanatory conditions such as cervical radiculopathy (especially C-6), elbow arthrosis or fibromyalgia. Some patients will have onset after a traumatic event, usually a relatively mild accident such as bumping the elbow on a hard surface; however this is not required to make a diagnosis.

Special Studies and Diagnostic and Treatment Considerations

Most patients require no special testing provided red flags are absent. For patients who have been treated for at least 4 weeks and symptoms have failed to improve, additional testing may be required. Some patients require testing to eliminate alternate diagnostic possibilities such as C-6 cervical radiculopathy (typically with MRI), fibromyalgia (requires a careful history and physical examination) or arthrosis (x-ray of the elbow). EMG may be used for cervical radiculopathy, but is recommended at least 6 weeks after symptom onset to allow sufficient time for EMG changes to be manifest (require 3 weeks minimum). While there are some studies utilizing ultrasound and MRI, there is no quality evidence that those tests alter the treatment plan and effect superior outcomes.

Initial Care

In employment settings where milder cases are more frequently seen, nonprescription analgesics may provide sufficient pain relief for most patients with acute or subacute elbow symptoms. In clinical settings, cases may be more severe and may require prescription analgesics as first-line treatments. If treatment response is inadequate, (i.e., symptoms and activity limitations continue), prescribed pharmaceuticals, orthotics, or physical methods can be added. Conservative care most often consists of activity modification using epicondylalgia supports (tennis elbow bands) and NSAIDs.

Monitoring Progress

Patients with epicondylalgia should generally have a follow-up visit in approximately 1 to 2 weeks to monitor medication use, splint use, activity modifications, and results of treatment to date. Less frequent follow-ups may be needed as patients improve, although more frequent follow-up is generally required if workplace limitations have been implemented.

Medications

Non-steroidal Anti-inflammatory Drugs (NSAIDs) and Acetaminophen (Including Cytoprotection)

NSAIDs are widely used for treatment of lateral epicondylalgia.(166-170) Acetaminophen is also widely used for this condition (see Hip and Groin Disorders chapter for mechanisms of action and classes of these medications).

1. *Recommendation: NSAIDs for Treatment of Acute, Subacute, Chronic, or Post-operative Epicondylalgia*
   NSAIDs are recommended for treatment of acute, subacute, chronic, or post-operative lateral epicondylalgia (see NSAIDs and Acetaminophen evidence table). Evidence is moderate for these settings except for post-operative where there is an absence of evidence.

   Indications – For acute, subacute, chronic, or post-operative epicondylalgia, NSAIDs are recommended for treatment. Over-the-counter (OTC) agents may suffice and be tried first.

   Frequency/Duration – Per manufacturer's recommendations. Trials have utilized diclofenac SR 75mg BID,(166) Naproxen 500mg BID,(167-170) and Diflunisal 1000mg then 500mg BID.(169, 170) However, there is no quality evidence an NSAID is superior to another for these indications. As needed, use may be reasonable for many patients. However, trials used scheduled doses.

   Indications for Discontinuation – Resolution of elbow pain, lack of efficacy, or development of adverse effects that necessitate discontinuation.

   Strength of Evidence – **Moderately Recommended, Evidence (B)** – Acute, subacute, chronic
   Recommended, Insufficient Evidence (I) – Post-operative

2. *Recommendation: NSAIDs for Patients at Risk for GI Adverse Effects*
   Concomitant prescriptions of cytoprotective medications are recommended for patients at substantially increased risk for gastrointestinal bleeding. There are four commonly used cytoprotective classes of drugs: misoprostol, sucralfate, histamine Type 2 receptor blockers (famotidine, ranitidine, cimetidine, etc.), and proton pump inhibitors (esomeprazole, lansoprazole, omeprazole, pantoprazole, rabeprazole). There is not generally believed to be substantial differences in efficacy for prevention of gastrointestinal bleeding(171) although evidence suggests the histamine-2 blockers are less effective for protection of the gastric mucosa and evidence also suggests sucralfate is weaker than proton pump inhibitors (see NSAIDs/acetaminophen evidence table). There also are combination products of NSAIDs/misoprostol that have documented reductions in risk of endoscopic lesions (see NSAIDs/acetaminophen evidence table).

   Indications – For patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications should be considered, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, elderly, diabetics, and cigarette smokers. Providers are cautioned that H2 blockers might not protect from gastric ulcers.(172-174)

   Frequency/Dose/Duration – Proton pump inhibitors, misoprostol, sucralfate, H2 blockers recommended. Dose and frequency per manufacturer. Duration is either that of the NSAID therapy, or sometimes permanent for those with recurrent bleeds or other complications.

   Indications for Discontinuation – Intolerance, development of adverse effects, or discontinuation of NSAID.

   Strength of Evidence – **Strongly Recommended, Evidence (A)** – Proton pump inhibitors, misoprostol
   Moderately Recommended, Evidence (B) – Sucralfate
   Recommended, Evidence (C) – H2 blockers

3. *Recommendation: NSAIDs for Patients at Risk for Cardiovascular Adverse Effects*
   Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

   Acetaminophen or aspirin as the first-line therapy appear to be the safest regarding cardiovascular adverse effects to use for these patients with cardiovascular disease risk factors.

   Strength of Evidence – **Strongly Recommended, Evidence (A)**

If needed, NSAIDs that are non-selective are preferred over COX-2 specific drugs. In patients receiving low-dose aspirin for primary or secondary cardiovascular disease prevention, to minimize the potential for the NSAID to counteract the beneficial effects of aspirin, the NSAID should be taken at least 30 minutes after or 8 hours before the daily aspirin.(175)

4. *Recommendation: Acetaminophen for Treatment of Elbow Pain*
Acetaminophen is recommended for treatment of elbow pain, particularly in patients with contraindications for NSAIDs.

Indications – All patients with elbow pain, including acute, subacute, chronic, and post-operative.

Dose/Frequency – Per 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;(176, 177) however, this level is now above the maximum dose recommended by an FDA advisory committee of 650mg and evidence of hepatic toxicity has been reported at 4 gm/day in a few days particularly among those consuming excessive alcohol. There is no quality evidence for superiority of 1gm dosing for treatment of osteoarthrosis.(176)

Indications for Discontinuation – Resolution of pain, adverse effects or intolerance.

Strength of Evidence **– Recommended, Insufficient Evidence (I)**

Rationale for Recommendations
There are a few quality trials for lateral epicondylalgia. The highest quality trial suggests diclofenac was effective compared with placebo for treatment of a mixture of acute, subacute, and chronic lateral epicondylalgia patients, although the magnitude of benefit was not large.(166) Another trial found naproxen superior to placebo for short-term duration,(168) although the same trial found a lack of benefit over a longer term compared with placebo.(167) One moderate-quality trial comparing flurbiprofen to piroxicam suggested flurbiprofen was superior,(178) thus piroxicam appears inferior for this indication. Two low-quality trials found equivalency between diflunisal and naproxen.(169, 170) However, no other quality studies suggest superiority of one oral NSAID over another or of one class over another, or for other musculoskeletal disorders (see other chapters). One low-quality trial suggested superiority of combining glucocorticosteroid injection with NSAID compared with NSAID alone at one month although it did not report longer term results.(179) (Toker 08) There are no quality studies of post-operative elbow pain; however, by analogy to other MSDs including hand surgeries (see Hand, Wrist, and Forearm Disorders chapter); successful treatment of elbow pain may be reasonably anticipated. While there are no quality trials for elbow disorders, COX-selective agents are reviewed in the Hip and Groin Disorders and Knee Disorders chapters; cytoprotective agents are reviewed in the Hip and Groin Disorders chapter. For most patients, generic ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Second-line medications should include one of the other generic medications. Acetaminophen (or the analog paracetamol) may be a reasonable alternative for these patients, although most evidence suggests acetaminophen is modestly less effective for arthrosis patients (see Hip and Groin Disorders chapter). There is evidence that NSAIDs are as effective for relief of pain as opioids and less impairing (see Chronic Pain and Low Back Disorders chapter) including tramadol,(180, 181) and dextropropoxyphene,(182) although slightly less efficacious than codeine.(183, 184) These medications are not invasive, have relatively low adverse effects profiles, particularly for short duration use in employed age groups, are low cost and thus are recommended.

Evidence for the Use of NSAIDs for Lateral Epicondylalgia
There are 1 high- and 2 moderate- (one with 2 reports) quality RCTs incorporated in this analysis. There are 3 low-quality RCTs(169, 170, 179) (Stull 86; Adelaar 87; Toker 08) in Appendix 1.

Topical NSAIDs and Other Agents

Topical NSAIDs have been utilized for epicondylalgia, both as a topical application,(185-189) as well as by iontophoresis treatment (see Iontophoresis section below).

Recommendation: Topical NSAIDs for Treatment of Acute, Subacute, Chronic, or Post-operative Epicondylalgia
Topical NSAIDs are recommended for treatment of acute, subacute, chronic, or post-operative lateral epicondylalgia.

Indications – For acute, subacute, chronic, or post-operative epicondylalgia, topical NSAIDs are recommended for treatment. For most patients, oral medications are recommended. However for those with contraindications for oral NSAIDs or intolerance, topical NSAIDs may be a reasonable alternative.

Frequency/Dose/Duration – Per manufacturer's recommendations. Quality trials have utilized DHEP lecithin 1.3% gel,(185) Flurbiprofen local-action transcutaneous patch (40 mg BID),(186) piroxicam gel (3cm, 0.5%, approximately

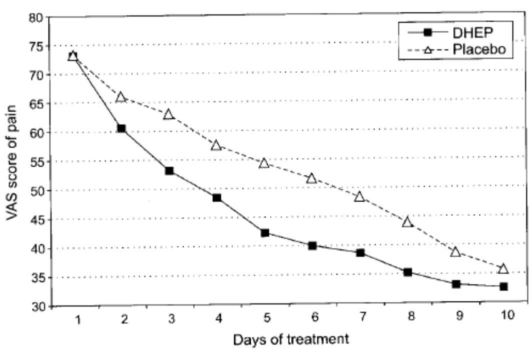
0.9g QID),(186) 2% diclofenac sodium in a pluronic lecithin liposome organo-gel (PLO)(187) and diclofenac sodium gel.(189) The one crossover trial suggests flurbiprofen was superior to piroxicam, which parallels the results of another RCT for the same two oral medications.

Indications for Discontinuation – Resolution of elbow pain, lack of efficacy, or development of adverse effects that necessitate discontinuation.

Strength of Evidence – **Moderately Recommended, Evidence (B)** – Acute, subacute, chronic
Recommended, Insufficient Evidence (I) – Post-operative

Rationale for Recommendations
Three placebo-controlled trials address topical NSAIDS for epicondylalgia.(185, 187, 189) The highest quality trial was for patients with acute pain who had excellent prognoses with resolution of the symptoms in a few days and consequently did not demonstrate a difference with placebo.(185) The other trials suggested superiority to placebo.(187, 189) The one randomized crossover trial found flurbiprofen superior to piroxicam,(186) suggesting piroxicam should not be either a first- or second-line treatment with either oral or topical preparations. Evidence is moderate for treatment of acute, subacute, or chronic patients. Quality evidence is absent for post-operative patients. There are no studies comparing topical agents with oral NSAIDs. Quality studies are available on topical NSAIDs including acute, subacute, and chronic lateral epicondylalgia patients and there is evidence of benefits. This option is not invasive, has low adverse effects, and is low cost for short-term use, although of higher cost for prolonged applications. Topical NSAIDs are recommended as a treatment option.

Figure 1. Visual Analog Scale (VAS) Scores of Pain in Patients Treated with DHEP Lecithin Gel and Placebo



Spacca G, Cacchio A, Forgács A, Monteforte P, Rovetta G. Analgesic efficacy of a lecithin-vehiculated diclofenacepolamine gel in shoulder periarthritis and lateral epicondylitis: a placebo-controlled, multicenter, randomized, double-blind clinical trial. *Drugs Exptl Clin Res.* 2005;31(4):147-54. Reprinted with permission from Dr. Stefano Rovati.

Evidence for the Use of Topical NSAIDs and Other Agents for Lateral Epicondylalgia
There are 4 moderate-quality RCTs and randomized crossover trials incorporated in this analysis. There are 3 low quality RCTs(188, 190, 191) (Kroll 89; Burton 88; Liow 02) in Appendix 1.

Opioids
Opioids are rarely used for treatment of patients with epicondylalgia. They are more frequently used briefly in the immediate post-operative period.

1. *Recommendation: Opioids for Select Patients with Post-operative Lateral Epicondylalgia*
   Opioids are recommended for select treatment of patients with post-operative lateral epicondylalgia.

   Indications – For post-operative epicondylalgia, a brief course of a few days to approximately a week of an opioid is recommended for treatment. Opioids may be helpful for brief nocturnal use after surgery. For other epicondylalgia patients, opioids are not recommended. Most patients should attempt pain control with NSAIDs prior to opioids. Wean from opioids as early as possible.

   Frequency/Dose/Duration – Per manufacturer's recommendations; generally patients require no more than a few days of treatment with opioids for most epicondylar surgeries.

   Indications for Discontinuation – Resolution of elbow pain, sufficient control with other medications, lack of efficacy, or development of adverse effects that necessitate discontinuation.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: Opioids for Acute, Subacute, or Chronic Lateral Epicondylalgia*
   Opioids are not recommended for acute, subacute, or chronic lateral epicondylalgia.

   Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendations
There are no quality studies evaluating opioids for treating lateral epicondylalgia. Opioids cause significant adverse effects – poor tolerance, constipation, drowsiness, clouded judgment, memory loss, and potential misuse or dependence have been reported in up to 35% of patients. Quality trials report that approximately 20 to 75% of patients are unable to tolerate these medications (see Chronic Pain chapter). Before prescribing opioids, patients should be informed of these potential adverse effects and cautioned against operating motor vehicles or machinery. Opioids do not appear to be more effective than safer analgesics for managing most musculoskeletal symptoms; they should only be used if needed for severe pain or for a short time in the post-operative time. Opioids are not invasive, have a high adverse effect profile, and are low cost. They are not recommended for treatment of epicondylalgia patients, except as a brief post-operative course.

Evidence for Use of Opioids for Lateral Epicondylalgia
There are no quality trials evaluating the use of opioids for treatment of pain from lateral epicondylalgia.

Physical Methods/Rehabilitation

There are a variety of physical methods which may be appropriate to use in the treatment of lateral epicondylalgia. However, as reviewed below, there is evidence of efficacy for certain methods, no evidence for several others, and evidence of a lack of efficacy for some. Some providers use a variety of procedures; yet conclusions regarding their effectiveness are not based on high-quality studies. Included among these interventions are epicondylalgia supports, exercise, heat/cold packs, manipulation, massage, friction massage, soft tissue mobilization, biofeedback, transcutaneous electrical neurostimulation (TENS), electrical stimulation (E-STIM), magnets, diathermy, and acupuncture. The provider should document objective evidence of functional improvement in order to assist with management of the disorder as well as to support whether or not to continue current treatment plans. This can be demonstrated by a combination of clinical improvement in disability questionnaires (e.g., DASH or Upper Extremity Function Scale), improvement in pain-free grip strength, or improvement in lifting ability, or some other functional activity (i.e., evaluate the patient's performance of an activity found to be limited at the time of the initial evaluation). Instead of focusing on a specific number of visits/treatment duration, identifying trends in the treatment provided are likely to be more helpful:

- Visit frequency should usually decrease over the episode of care, with the patient performing exercises more independently and the therapist's role becoming more consultative and coaching, assisting in progression of exercise and encouraging the patient.
- The use of physical agents and manual procedures should be weaned from supervised treatment either entirely, or limited to home use.
- It is reasonable to expect that if a particular treatment is going to benefit a particular patient, beneficial effects should be evident within 2 to 3 visits. Continuing with a treatment that has not resulted in objective improvement beyond approximately 5 or 6 treatments is not reasonable. Treatment that has not resulted in improvement after a couple of visits should either be modified substantially or discontinued.
- It should be expected that most patients with more severe conditions receive 8 to 12 visits over 6 to 8 weeks as long as functional improvement and program progression are documented. Patients with mild symptoms may require no therapy appointments or only a few appointments. Those with moderate problems may require 5 to 6 visits.

Epicondylalgia Supports (Tennis Elbow Bands, Braces or Epicondylitis Straps)

Tennis elbow straps and braces have been used for treatment of lateral (and medial) epicondylalgia.(165, 190, 192-216) (Johnson 07; Burton 88; Callaghan 07; Dwars 90; Faes 06; Struijs 04; van de Streek 04; Haker 93; Hijmans 04; Struijs 02; Struijs 01; Borkholder 04; Mellor 03; Bisset 05; Svernlov 01; Foye 07; Luginbuhl 08; Altan 08; Garg 10; Assendelft 03; Assendelft 04; Scher 09; Buchbinder 07; Buchbinder 08; Gottschalk 10; Vrettos 05; Struijs 06)

1. *Recommendation: Tennis Elbow Bands, Straps, and Braces for Acute, Subacute, and Chronic Lateral Epicondylalgia*
   Tennis elbow bands, straps and braces are recommended for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Indications – Acute, subacute and chronic epicondylalgia.

Frequency/Dose/Duration – Devices generally worn daily, but not at night, or as-needed for more forceful exertions (discontinue for less forceful activities during daily routine).

Indications for Discontinuation – Resolution of elbow pain, intolerance, lack of efficacy, or pain radiating down the dorsum of the forearm into the hand and/or numbness of the dorsum of the hand.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: Cock-up Wrist Braces for Acute, Subacute, or Chronic Lateral Epicondylalgia*
Cock-up wrist braces are recommended for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Indications – Acute, subacute, or chronic epicondylalgia. Generally, elbow bands and straps are recommended first, with wrist braces as possible adjunctive treatment for either more severe cases and/or suboptimal results with elbow bands and straps.(217) (Jafarian 09)

Frequency/Dose/Duration – Devices generally worn daily (not at night), or as-needed for more forceful exertions (discontinue for less forceful activities during daily routine).

Indications for Discontinuation – Resolution of elbow pain, intolerance or lack of efficacy.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
Three moderate-quality trials assessed utility of these devices for treatment of epicondylalgia – one compared a brace with no brace, but no sham-controlled trial. The trial comparing a brace to no brace used a brace that is not commonly used (an off-loader wrist brace). Additionally, this specific device was found to interfere with some workers' jobs.(194) One moderate-quality trial compared a brace, ultrasound and laser with exercises as co-interventions for all patients, finding mostly non-significant differences.(218) Another moderate-quality trial compared an elbow band with a combination of an elbow band and a wrist splint, suggesting the wrist splint provided no additive benefit while also interfering with work.(196) Another study evaluated physical therapy, a brace or both for treatment of lateral epicondylalgia; however, as the physical therapy regimen was not specified, the results are uninterpretable.(195) One low-quality trial found equal efficacy for wrist supports compared with elbow bands (see Appendix 1: Low-quality Randomized Controlled Trials and Non-randomized Studies).(207) Braces, straps and bands are not invasive, have low adverse effects, are low cost, and are recommended. There is no moderate or high quality evidence for use of wrist braces for treatment of lateral epicondylalgia. One low-quality trial has suggested efficacy (208), (Garg 10) however, a randomized crossover experimental design with only immediate results and without followup found some evidence suggesting elbow straps and sleeves may be superior to wrist braces.(217) (Jafarian 09) Some believe these braces rest the wrist and thus the extensor mechanism. Considering the off-loader wrist brace appears successful, other wrist braces may be reasonable options. Since available evidence does not suggest that elbow straps and braces are clearly superior to wrist braces, it may be reasonable to employ a wrist brace first in select cases after discussion with the patient regarding comfort, job requirements, other functional requirements of hand and wrist, and patient tolerance.

Evidence for the Use of Epicondylalgia Supports
There are 5 moderate-quality RCTs or randomized crossover trials (one with two reports) incorporated into this analysis. There are 7 low-quality RCTs or psuedorandomized controlled trials (190, 193, 206-208, 219, 220) and 2 experimental studies (217, 221) (Jafarian 09; Ng 04) in Appendix 1.

Exercises
Home exercises and supervised exercise programs are frequently used for treatment of lateral epicondylalgia, although exercise is often combined with other treatments.(12, 13, 195, 203, 204, 206, 222-230) (Coombes 13)

1. *Recommendation: Home Exercises for Acute, Subacute, Chronic, or Post-operative Lateral Epicondylalgia*
Home exercises are recommended for the treatment of acute, subacute, chronic, or post-operative lateral epicondylalgia.

Indications – For acute, subacute, chronic and post-operative epicondylalgia patients.

Frequency/Dose/Duration – Exercises are generally individualized and increased over time. Stretching exercises are frequently included and often are progressed to strengthening exercises. However, there is no quality evidence to recommend one exercise regimen in preference to another. There also is no quality evidence in favor or against any single type of exercise (e.g., stretching or strengthening; eccentric or concentric). Frequency ranges from daily to three times daily.

Indications for Discontinuation – Resolution of elbow pain, intolerance or lack of efficacy.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: Physical or Occupational Therapy for Acute, Subacute, Chronic, or Post-operative Lateral Epicondylalgia*

Physical or occupational therapy is recommended for the treatment of acute, subacute, chronic, or post-operative lateral epicondylalgia.

Indications – For highly select acute, subacute, chronic and post-operative epicondylalgia patients. Generally moderately to severely affected patients are thought to be better candidates for supervised therapy sessions. Milder cases may benefit from no more than 2 or 3 appointments to help educate, prevent debility, and institute a home exercise program. One moderate-quality trial suggested no benefits from earlier physical therapy.(231) (Park 10)

Frequency/Dose/Duration – Exercises are generally individualized and increased over time. Many therapists combine exercises with other treatment modalities. Stretching exercises are frequently included and progress to strengthening exercises. However, there is no quality evidence to recommend one exercise regimen in preference to another. There also is no quality evidence in favor or against any single type of exercise (e.g., stretching or strengthening). Frequency of appointments is usually individualized based on severity of the disorder, prior response to treatment, and job demands. Two to three appointments per week for two weeks are often used to initiate an exercise program for more severely affected patients. Total numbers of appointments may be as few as 2 to 3 for mild patients or up to 12 to 15 for more severely affected patients.

Indications for Discontinuation – Resolution of elbow pain, intolerance, lack of efficacy or non-compliance including non-compliance with home exercises prescribed.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendations

There are multiple randomized studies of exercise; however, there is no trial with a sham group. There also is no quality trial with only exercise as an isolated intervention. One high-quality trial suggested no long-term benefits of exercise for treatment of chronic lateral epicondylalgia patients, resulting in downgrading of this recommendation and inclusion of more selective criteria.(230) (Coombes 13) One moderate-quality trial suggested no benefits from immediate compared with delayed physical therapy.(231) (Park 10) There is one trial comparing physiotherapy with wait and see and injection; however, the physiotherapy included multiple cointerventions that also included manipulation.(13, 232) This trial also found equivalency between the physiotherapy and wait-and-see groups at one year, although injection was superior in the short-term. The other moderate-quality trial with a noninterventional control group appears underpowered, as there were small sample sizes and trends in the data in support of exercise.(233) That trial also found no additive benefit of exercise in addition to glucocorticoid injection, although trends in support of a combined approach were also present in the data. One moderate-quality trial found an exercise group superior to ultrasound, potentially suggesting modest benefits from exercise(226) and the follow-up study also reported superior results with less need of surgery in the exercise group compared to ultrasound (6% vs. 36%).(234) Most trials have unstructured physical therapy that precludes identification of the effects of a specific exercise program, although one trial failed to discern differences between eccentric and concentric exercises.(227) Thus, there is no quality evidence of efficacy of exercise. Nevertheless, the large numbers of trials with exercise included as a co-intervention(12, 13, 195, 203, 204, 222-228, 235) documents that exercise is thought to be important for treatment and recovery. Exercise is not invasive, has low adverse effects, is low to high cost depending on numbers of treatments and is recommended.

Evidence for Exercise Programs for Lateral Epicondylalgia

There are 2 high- and 9 moderate-quality RCTs (one with 2 reports) incorporated into this analysis. There are 6 low-quality RCTs or pseudorandomized controlled trials(193, 204, 206, 220, 236, 237) (Dwars 90; Svernlov 01; Luginbuhl 08; Clements 93; Croisier 07; Tyler 10) in Appendix 1.

Heat or Cold Packs

Heat and cryotherapy have been used for treatment of lateral epicondylalgia.(227, 238)

Recommendation: Self-application of Heat or Cold for Acute, Subacute, Chronic, or Post-operative Lateral Epicondylalgia

Self-application of heat or cold is recommended for the treatment of acute, subacute, chronic, or post-operative lateral epicondylalgia.

Indications – For acute, subacute, chronic and post-operative epicondylalgia patients.

Frequency/Dose/Duration – Heat or cold may be reasonable treatments as self applications, approximately 3 to 5 times a day.

Indications for Discontinuation – Resolution of elbow pain, intolerance or lack of efficacy.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation

There are no quality trials of heat. There is one moderate-quality trial comparing ice after exercise vs. exercise alone and found no evidence ice improved pain relief.(238) Another trial included ice massage as a co-intervention.(227) Heat and cryotherapy are not invasive, have low adverse effects and may have no cost for at-home applications and are thus recommended. Lack of evidence of efficacy and cost considerations do not support in-therapy applications and thus these are not recommended.

Evidence for the Use of Heat or Cold Packs for Lateral Epicondylalgia

There is 1 moderate-quality psuedorandomized pilot trial incorporated into this analysis.

Iontophoresis

Iontophoresis with administration of either glucocorticosteroids or NSAIDs has been used for treatment of lateral epicondylalgia.(11, 239-243)

Recommendation: Iontophoresis for Acute, Subacute, or Chronic Lateral Epicondylalgia

Iontophoresis with administration of either glucocorticosteroids or NSAIDs is moderately recommended for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Indications – For acute, subacute, or chronic epicondylalgia patients; patients who cannot tolerate oral NSAIDs; or patients who fail other treatments (e.g., insufficient pain relief with elbow straps and activity modification) may be ideal candidates. Generally moderately to severely affected patients are thought to be better candidates.

Frequency/Dose/Duration – Various medications have been used in the quality studies. These include dexamethasone,(11, 239) naproxen,(241) and ketorolac.(240) There are no quality comparative trials to suggest one regimen is superior to another with the exception that sodium salicylate was inferior to diclofenac.(242) The highest quality study utilized a regimen of 6 treatments over 15 days.(11) Thus, 6 treatments over 15 days are recommended. One additional set of up to 6 more treatments should be based on objective evidence of continuing functional improvements.

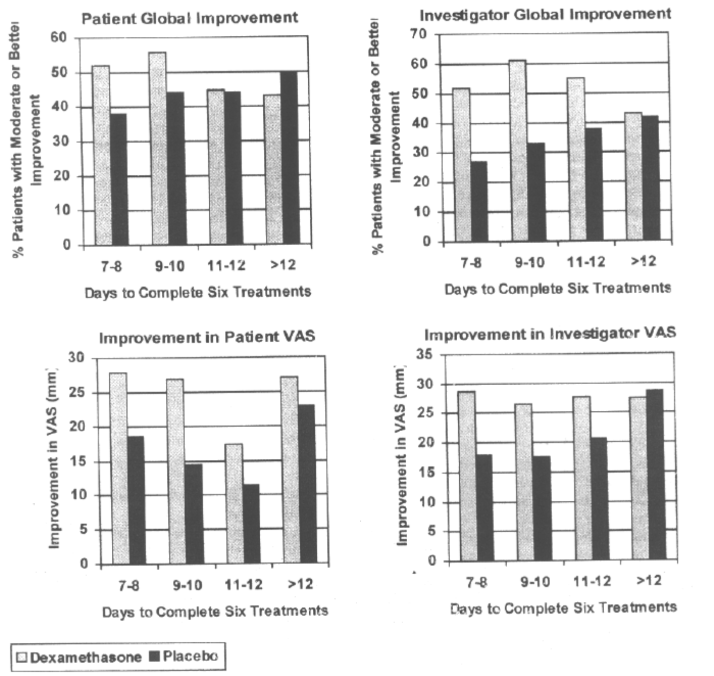
Indications for Discontinuation – Resolution of pain, intolerance, lack of efficacy or non-compliance.

Strength of Evidence – **Moderately Recommended, Evidence (B)**

Rationale for Recommendation

There are four moderate-quality trials. The highest quality trial suggested efficacy of dexamethasone compared with placebo.(11) The other study comparing dexamethasone with placebo was lower quality, substantially smaller in size and found lack of efficacy, though may have been underpowered.(239) Two other placebo-controlled trials found efficacy, one with ketorolac(240) and the other with diclofenac.(243) All trials suggest no more than modest improvements. One trial compared two methods of administering naproxen and found equal efficacy.(241) However, another moderate quality trial found diclofenac superior to sodium salicylate.(242) Iontophoresis with glucocorticoids or NSAIDs are not invasive, have low adverse effects, are moderately costly and are recommended.

Figure 2. Summary of Efficacy Results by Length of Time in which Patients Completed Treatments



VAS, visual analog scale score

Nirschl RP, Rodin DM, Ochiai DH, Maartmann-Moe C, *Am J Sports Med*, Iontophoretic administration of dexamethasone sodium phosphate for acute epicondylitis. A randomized, double-blinded, placebo-controlled study, 31(2), 189-95, Copyright© 2003 by American Orthopaedic Society for Sports Medicine. Reprinted by permission of Sage Publications.

Evidence for the Use of Iontophoresis for Lateral Epicondylalgia
There are 6 moderate-quality RCTs incorporated into this analysis.

Ultrasound

Ultrasound has been used for the treatment of epicondylalgia.(112, 203, 218, 223, 224, 226, 244-250)

Recommendation: Ultrasound for Acute, Subacute, or Chronic Lateral Epicondylalgia
Ultrasound is recommended for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Indications – For acute, subacute, or chronic epicondylalgia patients; patients who cannot tolerate oral NSAIDs and exercise; or patients who fail other treatments (e.g., insufficient pain relief with elbow straps and activity modification) may be ideal candidates. Generally moderately to severely affected patients are thought to be better candidates. Overall effect of ultrasound appears modest, thus other interventions are recommended first, particularly exercise.(226)
Frequency/Dose/Duration – Various regimens have been utilized in the quality studies. The two trials showing the most benefit utilized 10 to 12 treatments (1.0MHz, 1-2W/cm^2 for 5 to 10 minutes per session) over 4 to 6 weeks.(112, 247) There are no comparative trials for different regimens.

Indications for Discontinuation – Resolution of pain, intolerance, lack of efficacy or non-compliance.

Strength of Evidence – **Recommended, Evidence (C)**

Rationale for Recommendation
There are two high- and two moderate-quality sham-controlled trials that address ultrasound. The two high-quality trials(246, 248) both found ultrasound ineffective while the two moderate-quality trials found it effective.(112, 247) However, the two moderate-quality trials both had larger sample sizes. (However, these are both older trials. Thus, the score may understate the true quality of the trials.) There is quality evidence that exercise is superior to ultrasound.(226) There also is evidence ultrasound is superior to chiropractic care.(235) Four moderate-quality trials included ultrasound as a co-intervention, thus utility of ultrasound is unable to be assessed from these studies.(12, 195, 251, 252) Thus, there is overall evidence of a modest benefit from ultrasound. Ultrasound is not

invasive, has few adverse effects, but is moderately costly. As the overall evidence is for a modest benefit, it is recommended particularly for patients who fail other interventions.

Evidence for the Use of Ultrasound for Lateral Epicondylalgia
There are 2 high- and 10 moderate-quality RCTs incorporated into this analysis. There are 2 low-quality RCTs(219, 244) in Appendix 1.

Manipulation and Mobilization

Soft tissue mobilization has been administered to patients with lateral epicondylalgia.(253, 254) (Sevier 99; Howitt 06) Manipulation has also been utilized for treatment of lateral epicondylalgia,(13, 232, 235, 251, 255-259) (Bisset 06; Bisset 09; Langen-Pieters 03; Struijs 03; Drechsler 97; Nourbakhsh 08; Vicenzino 01; Radpasand 09; McHardy 08) including manipulation of the cervical spine.(260)

1. *Recommendation: Soft Tissue Mobilization for Acute, Subacute, or Chronic Lateral Epicondylalgia*
   Soft tissue mobilization is not recommended for the treatment of acute, subacute, or chronic lateral epicondylalgia.

   Strength of Evidence – **Not Recommended, Evidence (C)**

2. *Recommendation: Manipulation and Mobilization for Acute, Subacute, or Chronic Epicondylalgia*
   Manipulation or mobilization is not recommended for the treatment of acute, subacute, or chronic lateral epicondylalgia.

   Strength of Evidence – **Not Recommended, Evidence (C)**

Rationale for Recommendations
One high-quality trial included manipulation in addition to exercises and found no long-term benefits. (230)(Coombes 13) There is 1 moderate-quality randomized controlled trial comparing the additive value of soft tissue mobilization to a combination of stretching exercises, computer workstation advice plus generic NSAID. (261) (Blanchette 11) As that trial also found no evidence of additive benefits of soft tissue mobilization, neither manipulation nor mobilization is recommended for treatment of lateral epicondylalgia.

While there are a few moderate-quality trials, there are no sham-controlled trials that address manipulation or for the treatment of lateral epicondylalgia. One moderate-quality trial utilized manipulation as a co-intervention, thus precluding use of the trial for evidence based guidance.(13, 232) Two other moderate-quality studies conflicted. One suggested manipulation (mostly of the wrist) was superior to a combination of friction massage, ultrasound and exercise.(251) The other suggested ultrasound was superior to chiropractic care.(235) Thus, the currently available evidence conflicts regarding whether manipulation is beneficial and there is no recommendation for or against use of manipulation.

Evidence for the Use of Manipulation and Mobilization for Lateral Epicondylalgia
There is 1 high- and 5 moderate-quality RCTs or randomized crossover experimental studies (one with two reports) incorporated in this analysis. There are 5 low-quality RCTs(190, 255, 256, 258, 260) (Radpasand 09) in Appendix 1.

Massage, Including Friction Massage

Massage, particularly friction massage, has been utilized for treatment of epicondylalgia.(12, 193, 195, 203, 223, 224, 251, 252, 262, 263) (Viola 98; Brosseau 02)

Recommendation: Massage, Including Friction Massage, for Acute, Subacute, or Chronic Lateral Epicondylalgia
There is no recommendation for or against the use of massage, including friction massage, for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality studies of massage for treatment of epicondylalgia. There are moderate-quality trials that included friction massage for lateral epicondylalgia, but none utilized a no-treatment or sham-control group. All moderate-quality trials had co-interventions,(12, 195, 251, 252) effectively precluding evidence-based guidance. Thus, there is no recommendation for or against the use of either massage or friction massage.

Evidence for the Use of Massage and Friction Massage for Lateral Epicondylalgia
There are 4 moderate-quality RCTs incorporated into this analysis. There is 1 low-quality RCT(193) in Appendix 1.

Magnets and Pulsed Electromagnetic Field

Recommendation: Magnets and Pulsed Electromagnetic Field for Acute, Subacute, or Chronic Lateral Epicondylalgia
There is no recommendation for or against the use of magnets and pulsed electromagnetic field for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality studies using magnets to treat lateral epicondylalgia. The one moderate-quality trial comparing pulsed electromagnetic field with sham and glucocorticoid injection appears to have been a mostly negative study for PEMF.(264) Quality studies suggest a lack of benefit for low back pain (see Low Back Disorders chapter). This option is low cost, has few adverse effects, and is not invasive. However, without quality evidence of efficacy, there is no recommendation for or against the use of magnets or pulsed electromagnetic field for epicondylalgia.

Evidence for the Use of Magnets for Lateral Epicondylalgia
There is 1 moderate-quality pseudorandomized clinical trial incorporated into this analysis.

Extracorporeal Shockwave Therapy

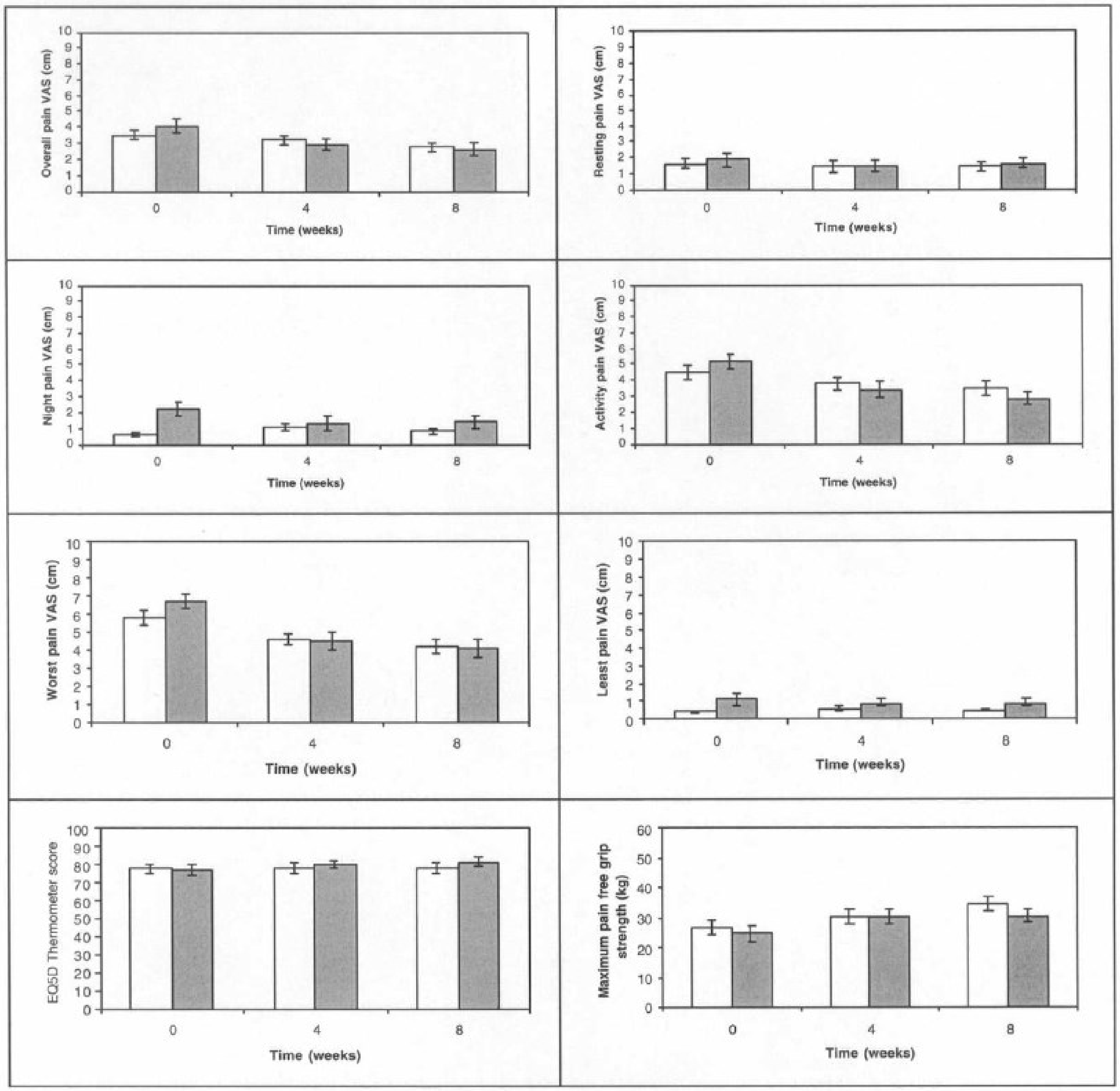
Extracorporeal shockwave therapy has been utilized for lateral epicondylalgia.(204, 265-282) (Sems 06; Stasinopoulos 05; Rompe 07; Ko 01; Ozturan 10)

Recommendation: Extracorporeal Shockwave Therapy for Acute, Subacute, or Chronic Lateral Epicondylalgia
Extracorporeal shockwave therapy is strongly not recommended for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Strength of Evidence – **Strongly Not Recommended, Evidence (A)**

Rationale for Recommendation
There are 9 high- or moderate-quality, sham-controlled (or low dose-controlled) trials that address extracorporeal shockwave therapy for epicondylalgia. All three high-quality sham-controlled trials, which included the largest sized study, failed to find evidence of efficacy.(266, 269, 283) Two moderate-quality trials suggested efficacy,(275, 284) (Pettrone 05; Spacca 05) while another moderate-quality trial was negative.(267) Three trials are of questionable quality due to methodological issues including one with mixed diagnoses.(272-274) The highest-quality evidence reports that extracorporeal shockwave therapy is not effective, not invasive, has some adverse effects, is moderately costly, and thus is not recommended.

Figure 3. Mean Visual Analog Scale (VAS), EuroQol 5D (EQ5D), and Maximum Pain-Free Grip Strength Scores for Sham and Active Extracorporeal Shock Wave Therapy (ESWT) Groups at 0, 4, and 8 Weeks



Unshaded bars represent sham ESWT group; shaded bars represent active ESWT group; error bars represent standard error of the mean.

Chung B, Wiley JP, Am J Sports Med, Effectiveness of extracorporeal shock wave therapy in the treatment of previously untreated lateral epicondylitis. A randomized controlled trial, 32(7), 1660-7, Copyright© 2004 by American Orhopaedic Society for Sports Medicine. Reprinted by permission of Sage Publications.

Evidence for the Use of Extracorporeal Shockwave Therapy for Lateral Epicondylalgia
There are 3 high- and 8 moderate-quality RCTs incorporated into this analysis. There are 4 low-quality RCTs(268, 270, 271, 285) (Rompe 01) in Appendix 1.

Phonophoresis

Phonophoresis has been used for the treatment of lateral epicondylalgia.(241, 245, 252)

Recommendation: Phonophoresis for Acute, Subacute, or Chronic Epicondylalgia
Phonophoresis is not recommended for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Strength of Evidence – **Not Recommended, Evidence (C)**

Rationale for Recommendation
There are four moderate quality trials that used phonophoresis.(241, 245, 252, 286) (Nagrale 09; Stratford 89) None of these trials documented efficacy of phonophoresis, thus phonophoresis is not recommended.
Evidence for the Use of Phonophoresis for Lateral Epicondylalgia
There are 4 moderate-quality RCTs incorporated into this analysis. There is 1low-quality RCT (219) in Appendix 1.

Low-Level Laser Therapy

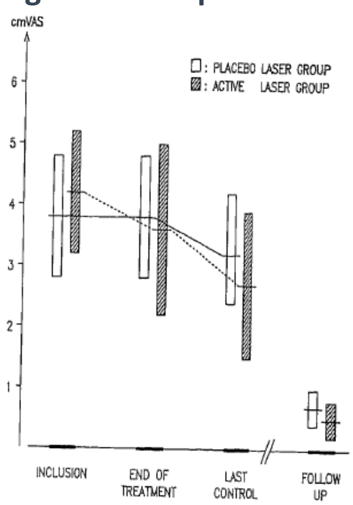
Low-level laser therapy has been used for treatment of lateral epicondylalgia.(203, 218, 287-300) (Chang 10; Bjordal 08; Stasinopoulos 09)

Recommendation: Low-Level Laser Therapy for Acute, Subacute, or Chronic Lateral Epicondylalgia
Low-level laser therapy is moderately not recommended for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Strength of Evidence – **Moderately Not Recommended, Evidence (B)**

Rationale for Recommendation
There are 12 high- and moderate-quality trials. The one high-quality trial suggested some benefit,(290) however, all the moderate quality trials were either completely negative or demonstrated no long term benefits.(287-289, 291, 293, 301, 302) Thus, absent quality evidence of efficacy, low-level laser therapy is not recommended.

Figure 4. Comparisons of Active and Placebo Laser Groups with Respect to VAS Scores



Each column gives the mean value with a 95% confidence interval. Data are given for start and end of treatment ("inclusion" and "end of treatment") and four weeks after treatment ("last control"). It should be emphasized that the study ended at the last control. Some patients needed additional treatments in the period between the last control and the follow-up session, and received various other treatment regimens until painfree or almost painfree.

Vasseljen O, Jr., Høeg N, Kjeldstad B, Johnsson A, Larsen S. Low level laser versus placebo in the treatment of tennis elbow. *Scand J Rehab Med.* 1992;24:37-42. Reprinted with permission from the Journal of Rehabilitation Medicine.

Evidence for the Use of Low-Level Laser Therapy for Lateral Epicondylalgia
There is 1 high- and 12 moderate-quality RCTs incorporated into this analysis. There are 2 low-quality RCT(292, 303) (Emanet 10) in Appendix 1.

Acupuncture

Acupuncture has been used for treatment of lateral epicondylalgia.(203, 224, 287, 304-313)

1. *Recommendation: Acupuncture for Select Chronic Lateral Epicondylalgia*
   Acupuncture is recommended for the treatment of select patients with chronic lateral epicondylalgia.

   Indications – Chronic epicondylalgia patients; patients who fail to sufficiently respond to treatment with NSAIDs (oral and/or topical), exercise, or patients who fail other treatments (e.g., insufficient pain relief with elbow straps and activity modification) may be ideal candidates. Glucocorticosteroid injections are also reasonable intervention(s) to attempt before acupuncture. Generally moderately to severely affected patients are thought to be better candidates. Overall benefits of acupuncture appear modest and efficacy appears to be transient, disappearing after a few weeks.

Frequency/Dose/Duration – Various regimens have been utilized in the quality studies. The sites used were LI 4, 10, 11; L5, SJ5, Ah-Shi over muscle origin of lateral extensor group(308) and the second used LI 4, 10, 11, 12, TW5.(305, 306) Both manually stimulated needles (de qi) placed for 15 to 20 minutes. Regimens were 2 to 3 treatments a week for 8 to 10 treatments.(305, 306, 308) Patients should demonstrate benefit after 4 to 5 appointments otherwise either the technique should be altered or acupuncture discontinued. The two trials showing the most benefit utilized 10 to 12 treatments (1.0MHz, 1-2W/cm^2 for 5 to 10 minutes a session) over 4 to 6 weeks.(112, 247) There are no comparative trials for different regimens.

Indications for Discontinuation – Resolution of pain, intolerance, lack of efficacy, or non-compliance.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

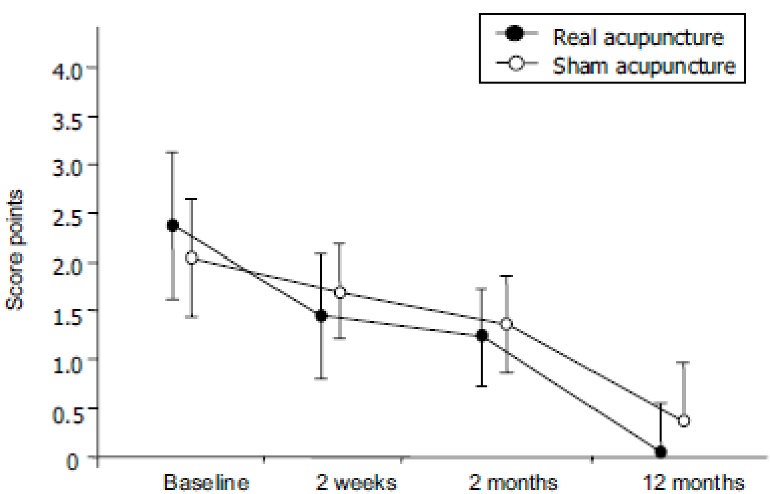
2. *Recommendation: Acupuncture for Acute, Subacute, or Post-operative Lateral Epicondylalgia*
There is no recommendation for or against the use of acupuncture for the treatment of acute, subacute, or post-operative lateral epicondylalgia.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendations

There are multiple moderate-quality trials of acupuncture for treatment of lateral epicondylalgia. There are 3 moderate-quality trials with 4 reports that attempted sham treatment. Two of those are potentially usable for purposes of developing guidance. One suggested potential modest short term benefit(305, 306) and the other suggest benefit of deep needle insertion compared with superficial needle insertion.(312) Another trial suggested comparable efficacy to ultrasound.(308) Thus, the overall quality of the literature is relatively weak, results are somewhat inconsistent. On average, they appear to suggest a modest, relatively short term benefit in mostly chronic patients. Acupuncture is minimally invasive, has few adverse effects in the extremities, and is moderately costly over several treatments. It is recommended for select patients with chronic epicondylalgia unresponsive to several other treatments.

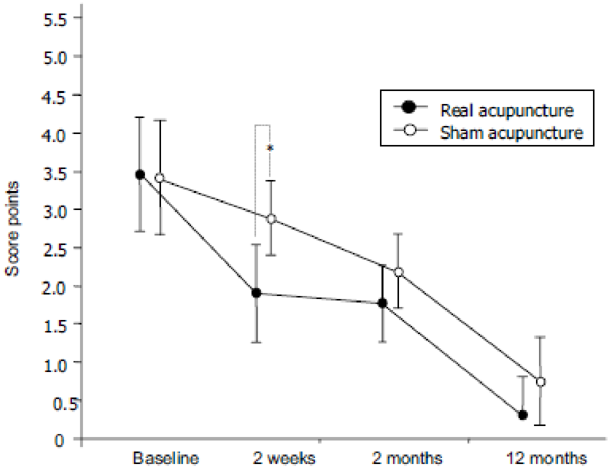
Figure 5. Pain at Rest



Mean ± SD of the verbal rating scale (0= no pain; 6= intractable pain) are depicted.

Fink M, Wolkenstein E, Luennemann M, Gutenbrunner C, Gehrke A, Karst M. Chronic epicondylitis: effects of real and sham acupuncture treatment: a randomized controlled patient-and examiner-blinded long-term trial. *Forsch Komplementärmed Klass Naturheilkd.* 2002;9(4):210-5. Reprinted with permission from S. Karger AG.

Figure 6. Movement Pain



Mean ± SD of the verbal rating scale (0= no pain; 6= intractable pain) are depicted. Significant differences are marked with (*).

Fink M, Wolkenstein E, Luennemann M, Gutenbrunner C, Gehrke A, Karst M. Chronic epicondylitis: effects of real and sham acupuncture treatment: a randomized controlled patient-and examiner-blinded long-term trial. *Forsch Komplementärmed Klass Naturheilkd.* 2002;9(4):210-5. Reprinted with permission from S. Karger AG.

Evidence for the Use of Acupuncture for Lateral Epicondylalgia
There are 6 moderate-quality RCTs (one with two reports) incorporated into this analysis. There is 1 low-quality RCT in Appendix 1.(313) (Tsui 02)

Biofeedback, TENS, E-Stim, Diathermy

Recommendation: Biofeedback, Transcutaneous Electrical Nerve Stimulation, Electrical Nerve Stimulation, and Diathermy for Acute, Subacute, or Chronic Lateral Epicondylalgia
There is no recommendation for or against the use of biofeedback, transcutaneous electrical nerve stimulation (TENS), electrical nerve stimulation, or diathermy for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendations
There is one high-quality trial of an electrical stimulation device, however it had a small sample size, used an electrical current not usually used in devices, and contained sparse results.(314) There are no other quality studies for or against the use of these treatments, thus there is no recommendation for or against their use.

Evidence for Biofeedback, Transcutaneous Electrical Nerve Stimulation, Electrical Stimulation, and Diathermy for Lateral Epicondylalgia
There is 1 high-quality randomized crossover trial incorporated into this analysis for electrical stimulation.(314) There is 1 low-quality RCT(315) on electrical stimulation and 1 low-quality randomized crossover trial on TENS (316) (Weng 05) in Appendix 1. There are no quality trials evaluating biofeedback, transcutaneous electrical nerve stimulation, or diathermy for the treatment of lateral epicondylalgia.

Injections

Glucocorticosteroid Injections

Glucocorticosteroid injections have long been used to treat lateral epicondylalgia.(12, 13, 167, 168, 222-224, 230, 232, 264, 317-328) (Torp-Pedersen 08; Smidt 02; Barr 09; Coombes 10; Weitoft 10) However, there are concerns that epicondylalgia is not an inflammatory condition, although the mechanism of action of glucocorticoids may not involve traditional anti-inflammatory properties. There also are concerns about worse long-term results with these injections.(12, 13, 69, 223, 224, 230) (Smidt 02; Bisset 06; Lindenhovius 08; Nimgade 05; Trudel 04; Coombes 13)

1. *Recommendation: Glucocorticosteroid Injections for Subacute or Chronic Epicondylalgia*

Glucocorticosteroid ("steroid") injections are recommended for the treatment of highly selective subacute or chronic lateral epicondylalgia.

Indications – Subacute or chronic epicondylalgia patients. Patients should have failed to respond sufficiently to treatment with multiple different NSAIDs (oral and/or topical), exercise, elbow straps and activity modification. Patients should be cautioned the symptoms frequently recur after injection. Moderately to severely affected patients are thought to be better candidates, particularly those thought to be surgical candidates who are attempting to delay surgery in the hopes that the pain subsides.

Frequency/Dose/Duration – All quality trials have performed 1 injection and assessed the results, rather than performing additional injections, unless the initial results were unsatisfactory. Most quality trials that described the injection techniques utilized the most tender point,(167, 168, 319) although two primarily targeted the tendon origin.(197, 328) (Krogh 13) Medications in these trials varied and included methylprednisolone 20mg;(167, 168) triamcinolone acetonide 10mg,(12, 13, 232, 318, 322) 20mg;(318) triamcinolone acetate;(319) hydrocortisone 25mg;(318) betamethasone 6mg;(222) triamcinolone 0.2mg;(197) and triamcinolone 40mg.(328) (Krogh 13) The one comparative trial suggested triamcinolone 10mg was superior to hydrocortisone 25mg.(318) Trials have combined these injections with injectable anesthetics (e.g., 0.5 to 2.0 mL 1% lidocaine);(167, 168, 318, 319) 1.0mL 2% lidocaine; 1% lignocaine;(230) (Coombes 13) and 4mL 0.25% bupivacaine.(222) The one comparative trial suggested bupivacaine was superior to lidocaine, and far outlasted the expected duration of anesthesia.(322) There also is some preliminary evidence that either dry needling or a multiple puncture technique ("peppering") may be effective, although none with a true control group for the technique (Stenhouse 13; Uygur 2017; Krogh 13; Altay 02; Dogramaci 2009).

Indications for Discontinuation – Resolution of pain, intolerance, lack of efficacy or non-compliance. Lack of response should result in reassessment of the diagnosis. Generally, there is an inclination to not use more than approximately 3 glucocorticoid injections in any one location for one episode. However, there is no evidence that there is or is not a limit on the number of injections either for an episode or for a lifetime. Subsequent injections should be supported by either objective improvement or utilization of a different technique or location for the injection(s).

Strength of Evidence –**Recommended, Evidence (C)**

2. *Recommendation: Glucocorticosteroid Injections for Acute Lateral Epicondylalgia*
There is no recommendation for or against the use of glucocorticosteroid ("steroid") injections for the treatment of acute lateral epicondylalgia.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

3. *Recommendation: Glucocorticosteroid Injections Using Bupivacaine for Subacute or Chronic Lateral Epicondylalgia*
Glucocorticosteroid ("steroid") injections using bupivacaine as an adjunct are recommended for the treatment of subacute or chronic lateral epicondylalgia.(322)

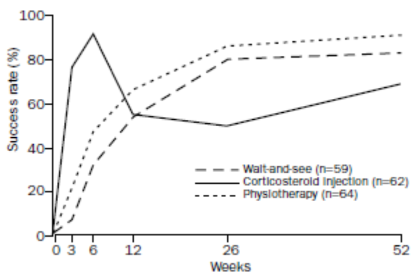
Strength of Evidence – **Recommended, Evidence (C)**

Rationale for Recommendations

One high-quality trial found superior results for glucocorticoid compared with saline at 4 weeks, but worse results at 1 year, including more recurrences.(230) (Coombes 13) Another high-quality trial found similar results over 3 months with the glucocorticoid outperforming both saline and platelet rich plasma injections. (328) (Krogh 13) Another high-quality trial found no difference with placebo injections at one month, though data appear to suggest a trend towards efficacy;(69) however, all moderate-quality trials comparing glucocorticosteroid injection with placebo found short- to intermediate-term benefits of injection.(167, 168, 318) Those results were essentially the same as the results that compared injection to no treatment ("wait and see").(12, 13, 232, 233) Thus, there is moderate quality evidence of short to intermediate term efficacy. Studies with follow-up to one year mostly found worse outcomes in the injection group or tends towards worse outcomes than physical therapy or a "wait and see" approach (see Figure 7).(12, 13, 69, 223, 224) These longer-term results caused this recommendation to be downgraded to only "C," as well as for the indications to quite restrictive. Caution is warranted for performing these injections and multiple other treatments should be attempted first. This also provides rationale for no recommendation for or against these injections in patients with acute lateral epicondylalgia. One moderate-quality trial reported glucocorticoid injection using a peppering technique superior to injection alone or anesthetic with peppering technique.(329) (Dogramaci 09) Studies comparing these injections with either platelet-rich plasma or autologous blood suggest the glucocorticosteroid was inferior.(282, 330-332) (Peerbooms 10; Gosens 11; Kazemi 10; Ozturan 10)

There are no quality trials of adjuvant treatment. One low-quality trial suggested superiority of combining glucocorticosteroid injection with NSAID vs. NSAID alone at one month.(179) (Toker 08) Injections are invasive, have modest adverse effects and are low to moderate cost. They are recommended for highly select cases of lateral epicondylalgia. The one comparative trial of injectable anesthetics found bupivacaine was superior to lidocaine and persisted to one year, thus well outlasted the expected duration of anesthesia. Consequently, adjuvant injection with bupivacaine is recommended.(322)

Figure 7. Success Rates of Three Treatment Regimens



Reprinted from The Lancet, 359, Smidt N, van der Windt DAWM, Assendelft WJJ, Devillé WLJM, Korthals-de Bos IBC, Bouter LM, Corticosteroid injections, physiotherapy, or a wait-and-see policy for lateral epicondylitis: a randomized controlled trial, 657-62, Copyright (2002), with permission from Elsevier.

Evidence for the Use of Glucocorticosteroid Injections for Lateral Epicondylalgia
There are 6 high- and 15 moderate-quality RCTs or pseudorandomized controlled trials (one with two reports) incorporated into this analysis. There are 3 low-quality RCTs(179, 244, 321) in Appendix 1.

Botulinum injections

Botulinum injections have been used for treatment of lateral epicondylalgia.(333-338) (Lin 10; Espandar 10; Kalichman 11)

Recommendation: Botulinum Injections for Acute, Subacute, or Chronic Lateral Epicondylalgia
Botulinum injections are not recommended for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendations
There are 4 high-quality trials comparing botulinum injections with placebo. Three of the studies suggest short to intermediate term benefits(334, 335, 337) (Espandar 10) and one does not (333) (Hayton 05) while one moderate-quality trial suggested superiority of glucocorticosteroid injections.(336) (Lin 10) Additionally, no quality studies with longer term follow-ups are available. Botulinum injections are invasive and there are reports of fatalities as well as muscle weakness,(334-337) (Placzek 07; Wong 05; Espandar 10; Lin 10) thus this intervention has major adverse effects which would appear to require considerable evidence of longer term efficacy to warrant. Thus, these injections are not recommended.

Evidence for Use of Botulinum Injections for Lateral Epicondylalgia
There are 4 high- and 1 moderate -quality RCTs incorporated into this analysis.

Platelet Rich Plasma Injections and Autologous Blood Injections

Platelet-rich plasma has been increasingly used to treat lateral epicondylitis as well as other tendinopathies.(339-345) (de Vos 10; Thanasas 11) Autologous blood injections have been similarly used.(282, 332, 345, 346) (Creaney 11; Kazemi 10; Ozturan 10; Thanasas 11) Efficacy is thought to be due to growth factors that are hoped will produce tissue regeneration including PD-EGF (platelet-derived epidermal growth factor), PDGF-A, PDGF-B (platelet-derived growth factor), TGF-β1 (transforming growth factor), IGF-I, IGF-II (insulin-like growth factor), VEGF (vascular endothelial growth factor), ECGF (endothelial cell growth factor), and bFGF (basic fibroblast growth factor).(339, 342)

1. *Recommendation: Platelet-rich Plasma Injections for Chronic Lateral Epicondylalgia*
   Platelet-rich plasma injections are recommended for the treatment of chronic lateral epicondylalgia.

Indications – Lateral epicondylalgia lasting at least 6 months, unresponsive or insufficiently responsive to other treatments including NSAID(s), straps, stretching and strengthening exercises, and at least one glucocorticosteroids injection.(331) (Peerbooms 10)

Dose/Frequency – Injection of approximately 3mL of platelet-rich plasma buffered with NS plus 8.4% sodium bicarbonate plus bupivacaine 0.5% with epinephrine (1:200,000) and used peppering technique.(331)

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: Autologous Blood Injections for Chronic Lateral Epicondylalgia*
Autologous blood injections are recommended for the treatment of chronic lateral epicondylalgia.

Indications – Lateral epicondylalgia lasting at least 6 months, unresponsive or insufficiently responsive to other treatments including NSAID(s), straps, stretching and strengthening exercises, and at least one glucocorticosteroids injection.(282, 332, 346) (Kazemi 10; Creaney 11; Ozturan 10)

Dose/Frequency – Withdrawal of 2mL of autologous blood from a peripheral vein, then injected into the most tender location(s).(331) (Peerbooms 10) One trial used ultrasound guidance; however, no comparative trial is available to suggest that results in superior results.(346) (Creaney 11)

Strength of Evidence – **Recommended, Evidence (C)**

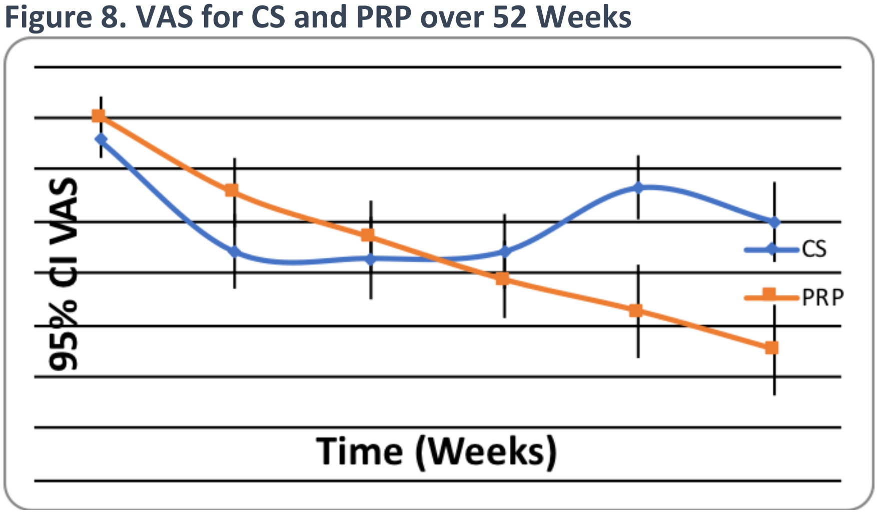
3. *Recommendation: Platelet-rich Plasma and Autologous Blood Injections for Acute or Subacute Lateral Epicondylalgia*
There is no recommendation for or against the use of platelet-rich plasma and/or autologous blood injections for the treatment of acute or subacute lateral epicondylalgia.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendations
There is one high-quality trial that found a lack of efficacy of platelet-rich plasma (PRP) injections compared with saline over 3 months. However, its data does not extend to 12 months(328) (Krogh 13) when other data suggest the greatest benefits are manifested.(328) (Krogh 13) There are no placebo controlled trials that address autologous blood (AB) injections for epicondylalgia. One moderate-quality comparative trial suggested comparable efficacy,(346) (Creaney 11) while another trial suggested modest superiority of PRP.(345) (Thanasas 11)

There is one high -quality trial comparing platelet-rich plasma with glucocorticosteroids (330, 331) (Peerbooms 10; Gosens 11) and suggested superiority of the PRP injection lasting at least 2 years.(330) (Gosens 11) One moderate-quality quasi-randomized trial suggested superiority of AB injections compared with glucocorticoid injections,(332)(Kazemi 10) and another moderate though lower quality trial suggested inferiority of AB to glucocorticoid injections at 4 weeks, but not over one year when AB was superior.(282) (Ozturan 10) These injections are invasive, have adverse effects, and are costly, but appear effective for select patients and are thus recommended for chronic epicondylalgia refractory to other treatments.

Figure 8. VAS for CS and PRP over 52 Weeks



Adapted from Peerbooms JC, Sluimer J, Bruijn DJ, Gosens T. Positive effect of an autologous platelet concentrate in lateral epicondylitis in a double-blind randomized controlled trial: platelet-rich plasma versus corticosteroid injection with a 1-year follow-up. *Am J Sports Med*. 2010;38(2):255-62.

Evidence for the Use of Platelet-rich Plasma and Autologous Blood Injections for Epicondylalgia
There are 2 high (one with 2 reports) and 2 moderate-quality RCTs incorporated into this analysis for platelet-rich plasma injections. There are 3 moderate-quality RCTs incorporated into this analysis for autologous blood injections.

Polidocanol Injections

Polidocanol injections have been utilized for treatment of lateral epicondylalgia.(347, 348)

Recommendation: Polidocanol Injections for Acute, Subacute, or Chronic Lateral Epicondylalgia
Polidocanol injections are not recommended for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Strength of Evidence – **Not Recommended, Evidence (C)**

Rationale for Recommendation
There is one moderate-quality, placebo-controlled trial of polidocanol injections.(348) It found no evidence of short- or intermediate-term benefits, thus polidocanol injections are not recommended.

Evidence for Use of Polidocanol Injections for Epicondylalgia
There is 1 moderate-quality RCT incorporated into this analysis.

Periarticular Viscosupplementation (Hyaluronate and Glycosaminoglycan) Injections

Sodium hyaluronate and glycosaminoglycan periarticular injections have been used for treatment of chronic lateral epicondylalgia.(349, 350) (Petrella 10; Akermark 95)

Recommendation: Periarticular Lateral Elbow Hyaluronate and Glycosaminoglycan Injections for Chronic Lateral Epicondylalgia
There is no recommendation for or against the use of periarticular viscosupplementation (sodium hyaluronate and glycosaminoglycan) injections for the treatment of chronic lateral epicondylalgia.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendation
One moderate-quality trial using glycosaminoglycan injections found conflicting results of efficacy for treating chronic lateral epicondylalgia between two participating centers that are not well explained.(350) (Akermark 95) Another moderate-quality trial suggested substantial efficacy of sodium hyaluronate in comparison with placebo.(349) (Petrella 10) These injections are invasive, have low risk of adverse effects, are at least moderately costly and results need replicating with quality trials before a recommendation may be supported.

Evidence for the Use of Periarticular Viscosupplementation Injections
There are 2 moderate-quality RCTs incorporated into this analysis.

Other Injections

Prolotherapy injections have been used for treatment of lateral epicondylalgia. Sonographically guided percutaneous tenotomy has also been attempted.(351, 352)

Recommendation: Prolotherapy or Sonographically Guided Percutaneous Tenotomy Injections for Acute, Subacute, or Chronic Lateral Epicondylalgia
There is no recommendation for or against the use of prolotherapy injections or sonographically guided percutaneous tenotomy for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendation

There is one pilot study of prolotherapy injections, but the data conflict regarding benefit and a larger sample size is required.(353) There are no quality studies for the use of percutaneous tenotomy, thus there is no recommendation for these injections.

Evidence for Use of Other Injections
There is 1 moderate-quality pilot study incorporated into this analysis.

Surgical Considerations

Surgery has been used to treat lateral epicondylalgia that does not respond to adequate trials of nonoperative care.(165, 354-366) (Coleman 10; Buchbinder 11) There are three main surgical approaches for lateral epicondylalgia – open,(354, 357, 363, 367-371) percutaneous,(362, 372) and arthroscopic.(355, 358, 371, 373-376) One review found no evidence of the superiority of one approach over another, and concluded that the choice should be left to the individual surgeon until quality evidence of a superior approach or technique becomes available.(358) Decompression of the posterior interosseous nerve and lengthening of the tendon has also been reported(354) with a presumptive diagnosis of possible radial nerve entrapment presenting as "resistant tennis elbow." A radiofrequency procedure (microtenotomy) has also been developed.(377)

1. *Recommendation: Lateral Epicondylar Release for Chronic Lateral Epicondylalgia*
   Surgical lateral epicondylar release is recommended for the treatment of chronic lateral epicondylalgia.

   Indications – The timing of surgery should be consistent with the degree of functional impairment and the progression and severity of objective findings. In contrast with severe entrapment neuropathies, lateral epicondylalgia does not generally produce unequivocally objective evidence of impairment or severe dysfunction, thus documentation of adequate trials of non-operative management in spite of compliance with treatment is particularly important.(354, 356, 377) Patients should generally have pain for at least 6 months,(354-356, 377) although there are some limited exceptions where as little as 3 months of non-operative management may be sufficient. There should generally be significant limitations, failure to improve with NSAIDs, elbow bands/straps, activity modification, and exercise programs to increase range of motion and strength of the musculature around the elbow.(354-356, 377) Patients should generally have failed glucocorticosteroid injection(s),(354-356, 377) ideally with documented short-term relief of injection(s).(377) Any of the 3 main surgical approaches are acceptable pending quality trials to further direct care (open, percutaneous and arthroscopic).

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: Radiofrequency Microtenotomy for Chronic Lateral Epicondylalgia*
   Radiofrequency microtenotomy is recommended for the treatment of chronic lateral epicondylalgia.(377)

   Indications – Same as above.

   Strength of Evidence – **Recommended, Evidence (C)**

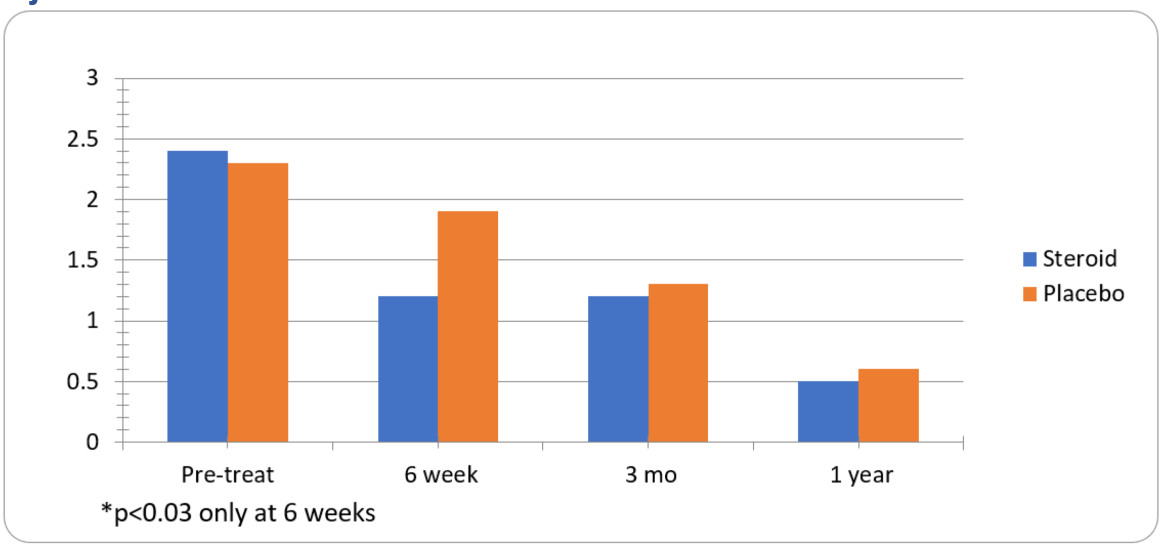
Rationale for Recommendations
There are no quality trials with sham surgical procedures, and no quality trials comparing surgery with a quality rehabilitation program, thus there is insufficient evidence for surgery. Nevertheless, carefully selected patients appear to do well with surgery. There is one moderate-quality trial suggesting superior results with a percutaneous release compared with an open release, including earlier return to work and patient satisfaction.(355) A moderate-quality trial comparing tenotomy with shockwave therapy found no significant differences, but may have been underpowered with some trends in favor of surgery.(277) There also is a trial suggesting no differences between surgery and botulinum injections, although trends of modestly better results with surgery were present.(356) A third moderate-quality trial suggested relatively less promising results with either surgical procedure for resistant tennis elbow.(354) Another study suggested that those treated with open (Nirschl) release surgery without drilling did better than those who had adjunctive drilling.(363) Thus, benefits of less invasive procedures are suggested in these studies. Lateral epicondylar surgery is invasive, has adverse effects, and is high cost, but lateral epicondylar release is recommended in select cases. One trial comparing lateral release with microtenotomy found the recovery to be modestly faster from microtenotomy, thus that procedure is recommended.(377)

Evidence for the Use of Surgical Interventions for Epicondylalgia
There are 6 moderate-quality RCTs incorporated into this analysis.

Medial Epicondylalgia (Medial Epicondylitis; Golfer's Elbow)

Medial epicondylalgia is much less common than lateral epicondylalgia, which is thought to be about seven times more common.(378) Medial epicondylalgia is sometimes thought to occur concomitantly with ulnar neuropathy at the elbow (see Ulnar Neuropathies at the Elbow Including Condylar Groove Ulnar Neuropathy and Cubital Tunnel Syndrome). While the evidence is somewhat unclear if treatment of medial epicondylalgia by analogy to lateral epicondylalgia is appropriate, it is assumed by the medical community that this is correct. The few quality trials of medial epicondylalgia also appear to suggest comparable results for the same treatments with lateral epicondylalgia(11, 170, 292, 378, 379) (see Figure 9. Pain Scores for Patients with Medial Epicondylalgia Treated with Steroid Injections). **Thus, recommended treatment of medial epicondylalgia is inferred from treatment of lateral epicondylalgia** [see Lateral Epicondylalgia (Lateral Epicondylitis, Tennis Elbow)]. This section presents the few studies that included patients with medial epicondylalgia.

Figure 9. Pain Scores for Patients with Medial Epicondylalgia Treated with Steroid Injections



Adapted from Stahl S, Kaufman T. The efficacy of an injection of steroids for medial epicondylitis. *J Bone Joint Surg.* 1997;79-A(11):1648-52.

Evidence for Medial Epicondylalgia

There is 1 high- and 1 moderate-quality RCT incorporated into this analysis. There are 2 low-quality RCTs(170, 292) (in Appendix 1.

Olecranon Bursitis

Diagnostic Criteria

Olecranon bursitis is a condition associated with a generally painless effusion of the olecranon bursa.(380-382) Acute olecranon bursitis may be slightly warm, but is generally non-tender or minimally tender. Septic (infected) olecranon bursitis is either a complication of aseptic olecranon bursitis or a direct consequence of trauma.(380) Generally, to be a complication of aseptic olecranon, bursitis also requires introduction of organisms through the skin, such as abraded skin or an injection, although systemic seeding may also occur. Signs include swelling, pain, tenderness, and pain on range of motion.(380-382) Bursitis due to crystal arthropathies also tend to present with findings similar to those of septic bursitis.(381)

Special Studies and Diagnostic and Treatment Considerations

There are no special studies for most cases of olecranon bursitis. If the bursa is thought to be potentially infected, aspiration of the fluid and analyses including Gram stain and culture and sensitivity are recommended.

1. *Recommendation: Fluid Aspiration and Analyses for Olecranon Bursitis*
   Aspiration of the fluid and analyses including Gram stain and culture and sensitivity are recommended to determine infection for olecranon bursitis.
   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: X-rays for Olecranon Bursitis*
   X-rays are recommended to rule out osteomyelitis or joint effusion in cases of significant septic olecranon bursitis.
   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Initial Care and Activity Modification

Most patients with olecranon bursitis are treated with soft elbow padding, support or an ace wrap, are instructed to avoid elbow pressure, and require no further care other than monitoring to assure resolution.

1. *Recommendation: Soft Padding, Soft Elbow Supports, and Ace Wraps for Olecranon Bursitis*
   Soft padding of the elbow, soft elbow supports, and ace wraps are recommended for olecranon bursitis.
   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality trials evaluating these modifications for treatment of olecranon bursitis. Most patients appear to resolve with non-invasive options. Soft padding, soft elbow supports, and ace wraps are not invasive, have few adverse effects, are low cost, and are recommended.

Evidence for the Use of Soft Padding, Soft Elbow Supports, and Ace Wraps for Olecranon Bursitis
There are no quality studies evaluating the use of soft padding, soft elbow supports, or ace wraps for olecranon bursitis.

2. *Recommendation: Modifying Activities to Avoid Direct Pressure Over the Olecranon*
   Modifying activities to avoid direct pressure over the olecranon and allowing time to reabsorb the fluid are recommended.
   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality trials. Most patients appear to resolve with non-invasive options including avoiding pressure on the olecranon. Activity modification is not invasive, has low or no adverse effects, is low cost and is recommended.

Evidence for the Use of Modifying Activities
There are no quality studies evaluating the use of modifying activities for olecranon bursitis.

Medications

Non-steroidal Antiinflammatory Drugs (NSAIDs)

Some patients with olecranon bursitis have been treated with NSAIDs, particularly if there is some accompanying discomfort.

Recommendation: NSAIDs for Olecranon Bursitis
There is no recommendation for or against the use of NSAIDs for the treatment of olecranon bursitis.
Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendation

There is one moderate quality trial that included arms comparing naproxen with placebo and failed to show efficacy.(383) (Smith 89) However, the arms comparing glucocorticosteroid injection with naproxen or placebo trended towards better results with the NSAID. Thus, as there is no clear quality evidence that NSAIDs alter the clinical course, there is no recommendation for or against their use for olecranon bursitis. The threshold for a trial of these medications is likely generally low.

Evidence for the Use of NSAIDs for Olecranon Bursitis
There is 1 moderate -quality RCT incorporated into this analysis.

Injection Therapies

Aspiration

Aspiration of the swollen bursa has been used for diagnosing septic olecranon bursitis, or if it is thought to be potentially infected.(381, 382, 384) (Weinstein 84) Aspiration has been reported in a low-quality study to have fewer complications than glucocorticosteroid injection.(384) (Weinstein 84)

Recommendation: Aspiration for Infected Bursa
Aspiration is recommended for a clinically infected or questionably infected bursa.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
Aspiration has been used for diagnosis, particularly when combined with Gram stain, culture and sensitivity, and complete cell count of the aspirated fluid are performed. Crystal examination (light polarizing microscopy) should also be performed at least once on the aspirated fluid. Aspiration of a bursa is invasive, has relatively low adverse effects although it can introduce an infection if one is not present, and is low to moderate cost, but is recommended for diagnosis and planning of treatment.

Evidence for the Use of Aspiration
There is 1 low-quality RCT in Appendix 1.(384) (Weinstein 84)

Glucocorticosteroid Injections

Injection with a glucocorticosteroid (typically doses of methylprednisolone approximately 20 to 40mg or equivalent), often accompanied by aspiration, is widely used for aseptic olecranon bursitis.(383, 384) (Weinstein 84; Smith 89)

Recommendation: Glucocorticosteroid Injections for Olecranon Bursitis
There is no recommendation for or against the use of glucocorticosteroid injections for the treatment of olecranon bursitis. This may be a reasonable option for patients who are failing to resolve prior to consideration of surgery.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendation
There is one moderate quality trial evaluating the use of glucocorticosteroid injections to treat olecranon bursitis.(383) (Smith 89) That study suggested injection with glucocorticosteroid sped resolution of the condition, and trended toward superior results if the injection was combined with oral naproxen rather than placebo. However, another study reported a 12% risk of septic complications and an RCT is generally underpowered to detect infectious complications. While the quality trial indicates faster resolution, the risk of infectious complications underscore caution about glucocorticoid injections as there is a potential to create a septic bursitis which then often requires surgical drainage. If attempted, these injections appear to be reserved for those thought to not be infected and not resolving with activity modifications and observation. If attempted, generally only one aspiration/injection is performed followed by careful observation. Some physicians aspirate and then inject, while others only inject the steroid. If the bursitis is not satisfactorily resolved, a second aspiration/injection is often attempted usually not sooner than 3 to 4 weeks later. The single quality trial used methylprednisolone acetate 20 mg.(383) Aspirated fluid should be sent at least once for studies including crystals (light polarizing microscopy), Gram stain, culture and sensitivity and complete cell count of the aspirated fluid are performed. Glucocorticosteroid injection is invasive, has relatively low adverse effects although it can introduce an infection if one is not present, and is moderately costly, and is recommended in those cases not trending towards resolution.

Evidence for the Use of Glucocorticosteroid Injections for Olecranon Bursitis
There is 1 moderate-quality RCT incorporated into this analysis.

Surgical Considerations

Surgery has been widely used to treat olecranon bursitis that has not responded to activity modifications and injections.(382)

1. *Recommendation: Surgical Drainage for Olecranon Bursitis*
   Surgical drainage is recommended for treatment of olecranon bursitis.

   Indications – Olecranon bursitis that is either infected, clinically thought to be infected, or not infected but present for at least approximately 6 to 8 weeks without trending towards resolution while being treated with soft padding and activity modifications above.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: Surgical Resection for Chronic Olecranon Bursitis*
   Surgical resection of the bursa is recommended for chronic olecranon bursitis with recurrent drainage.

   Indications – Olecranon bursitis with recurrent drainage.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendations
There are no quality trials. Surgical drainage of a swollen olecranon bursa has been successfully used for treatment of olecranon bursitis. As it is not without potential complications, however, it is recommended to be reserved for select cases either involving infection or failure to respond to an adequate trial of non-operative measures. Surgical drainage is invasive, has modest adverse effects for this particular surgery, is moderate to high cost, but is recommended in those cases not trending towards resolution or which are thought to be infected.

Elbow Fractures, Including Non-Displaced Radial Head Fractures

Elbow fractures most commonly occur from falls. Radial head fractures typically occur from falls onto an outstretched hand. If the fracture is large and displaced or comminuted (Type III) or there is a large fracture with a displaced fragment (Type II), surgical referral is indicated. Capitellar fractures are rare(385-390) and usually occur from falling on an outstretched hand. Non-operative management is sometimes attempted, however most are believed to require surgical fixation.(388) Surgical repairs are often performed for these fractures.(391-399)

Diagnostic Criteria

A clinical impression is made upon history of appropriate injury mechanism and physical examination findings of substantial tenderness particularly focally over a bone. Findings of (in)ability to use the elbow should be sought, as well as inspection for signs of deformity. The elbow extension test (whether the elbow can be fully extended) has been reported to be 96.8% sensitive and 48.5% specific for detection of an elbow fracture in a series of 1,740 patients with an acute elbow injury.(400) The negative predictive value was 98.4%. A fracture identified on x-rays, generally 2 to 3 views, confirms that diagnostic impression. The differential diagnosis prominently includes elbow sprain and dislocation. If x-rays are negative and clinical suspicion high, a CT is usually the next test.

Special Studies and Diagnostic and Treatment Considerations

X-Rays

Recommendation: X-rays for Elbow Fracture
X-rays that include at least two to three views are recommended to diagnose elbow fractures.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation

There are no quality studies evaluating x-rays for elbow fractures. However, x-rays have been used for decades to identify those fractures requiring surgical treatment, and evaluate for healing; thus, they are recommended to diagnose elbow fractures.

Initial Care and Medications

NSAIDs snd Acetaminophen

Recommendation: NSAIDs and Acetaminophen for Treatment of Elbow Fractures
NSAIDs and acetaminophen are recommended to control pain associated with elbow fractures.

Indications – Pain due to fracture.

Frequency/Duration – Scheduled dosage rather than as needed is generally preferable.

Indications for Discontinuation – Resolution of pain, lack of efficacy, or development of adverse effects particularly gastrointestinal.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There is no quality evidence for or against the use of NSAIDs or acetaminophen. These medications have been found useful in other musculoskeletal injuries and by inference may be efficacious for control of swelling and pain in the initial stages of injury, although some concerns about healing of bones have been raised. Other studies have suggested no delayed bone healing (see Distal Forearm Fractures in Hand, Wrist, and Forearm Disorders chapter).

Cast Immobilization/Splints and Slings

Casting has been long used to treat elbow and other fractures. Non-displaced radial head fractures have been treated with slings.

1. *Recommendation: Elbow Slings for Non-displaced and Occult Radial Head Fractures*
   Elbow slings are recommended for treatment of non-displaced and occult radial head fractures.

   Indications – Non-displaced radial head fractures and occult fractures. Occult fractures are not visible on x-rays but are suspected by including either the lack of full extension of the elbow or evidence of effusion on x-ray.

   Frequency/Duration – Sling (or splint) use for non-displaced radial head fractures is for 7 days. (A shorter complete immobilization period of as little as 3 days may be used for non-displaced fractures that are clinically present but not visible on an x-ray.) After 7 days, gentle range-of-motion exercises within pain tolerance should begin,(37) followed by progressive mobilization. (One low-quality trial suggested superior results with immediate mobilization of non-displaced radial head fractures (191) (Liow 02)).

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality trials evaluating splints or slings to treat radial head fractures. These fractures have excellent prognoses with short-term sling or splint use. Longer term sling or splint use may be necessary particularly where there is potential for high force use or exposure. Range-of-motion exercises should primarily involve the elbow, but should also include the shoulder (to prevent frozen shoulder), and the wrist. Limited mobility may be achieved with a sling, cast, or posterior elbow splint wrapped over the joint with a tensor at 90° flexion. A thermoplastic splint with Velcro straps may also be used. As pain diminishes, the unresisted active movement should be increased to pain tolerance to prevent or minimize contracture. Quality studies are not available on these treatment options and there is no evidence of their benefits. However, these options are low cost, have few adverse effects, and are not invasive. Thus, while there is insufficient evidence as to the benefits of these options, they are recommended.

2. *Recommendation: Casts for Select Elbow Fractures*
   Casts and cast bracing are recommended for treatment of non-displaced or occult radial head fractures.

   Indications – Minimally displaced fractures and other elbow fractures felt amenable to casting, cast bracing, or post-open reduction internal fixation fractures.

   Frequency/Duration – Casts are generally required for 6 weeks or until adequate healing is documented on x-ray. After successful healing, they should be followed by progressive mobilization.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality trials regarding the use of casts or cast bracing to treat non-displaced or occult radial head fractures of the elbow. Many of these fractures require surgical fixation. Post-operatively they are usually casted. Select elbow fractures may be amenable to casting, rather than surgical fixation. Casting is moderately costly, has some adverse effects, and is not invasive. While there is insufficient evidence of success compared with other treatments, they are recommended.

Evidence for the Use of Immobilization for Elbow Fractures
There are no quality studies evaluating the use of immobilization for elbow fractures. There is 1 low-quality RCT(401) in Appendix 1.

Opioids

Some patients with fractures have been treated with opioids for pain.

Recommendation: Opioids for Select Patients with Pain from Elbow Fractures
Opioids are recommended for treatment of select patients with pain from elbow fractures.

Indications – Select patients with severe pain from elbow fracture with insufficient control from other means, including acetaminophen and NSAIDs or with contraindications for NSAIDs. Patients with more severe fractures or in the immediate post-operative period may require opioids for pain management. Considerable cautions are recommended concerning opioids and minimum numbers of doses should be prescribed as duration of treatment for elbow fractures is usually limited.

Frequency/Dose – As needed. For the few patients requiring opioids, the majority need at most a few days treatment and then generally have insufficient pain for further treatment with opioids.

Indications for Discontinuation – Resolution of pain sufficiently to not require opioids, consumption that does not follow prescription instructions, adverse effects.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality trials evaluating the use of opioids to control pain from elbow fractures. Most patients do not require opioids. Some patients, particularly with more severe fractures may require opioids briefly during the post-operative period after fixation. There is no quality evidence supporting the use of opioids for treating these patients, but they address pain management. There are major concerns regarding adverse effects of opioids including mortality. However, it is presumed that few doses combined with short-term use provides sufficient margin of safety for these medications. Opioids are not invasive, are low cost, but have high adverse effect profiles. They are recommended for limited-duration use in select patients with elbow fractures.
Evidence for the Use of Opioids for Elbow Fractures
There are no quality studies evaluating the use of opioids for patients with pain from elbow fractures.

Surgery

Displaced fractures and fracture fragments are believed to require surgical treatment with fixation, but there are no quality studies of displaced fractures. Widely displaced fracture and/or comminuted fragments may require radial head excision and/or radial head implant. Indications to surgically fix elbow fractures are not well defined, and there is a suggestion that some patients are better candidates than others (e.g., widely displaced fragments, or requirement for earlier recovery such as in professional athletes, terrible triad patients).(402, 403) Until sufficient quality evidence becomes available, the decision to surgically treat elbow fractures is a decision between the orthopedist and patient.

Recommendation: Surgical Fixation of Displaced Elbow Fractures
Surgical fixation is recommended for displaced elbow fractures.

Strength of Evidence **– Recommended, Insufficient Evidence (I)**

Rationale for Recommendation

There are no quality trials of fixation compared with casting or other treatment. Many of these fractures do not appear to do well without surgery, thus fixation is currently used for many of these fractures. There is one moderate quality trial comparing two types of fixation that suggested comparable results.(404) (Helling 06) Widely displaced fracture and/or comminuted fragments may require radial head excision and/or radial head implant. Some are treated with arthroplasty. Surgical fixation is invasive, has adverse effects and is costly, however benefits appear to outweigh risks and fixation is recommended for many of these patients.

Evidence for the Use of Surgery for Elbow Fractures
There is 1 moderate-quality RCT incorporated into this analysis.

Physical Methods/Rehabilitation

1. *Recommendation: Education after Cast Removal for Elbow Fracture*
   Education is recommended for select patients needing education after cast removal for elbow fracture.
   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: Physical or Occupational Therapy of Patients After Cast Removal*
   Physical or occupational therapy is recommended for select patients with functional debilities, or those unable to return to work after cast removal for elbow fracture.
   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

3. *Recommendation: Routine Referral After Cast Removal*
   Routine referral for physical or occupational therapy after cast removal for elbow fracture of otherwise healthy patients who are able to return to work is not recommended.
   Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendations
There are no quality studies evaluating physical or occupational therapy for rehabilitation of patients with elbow fractures. These therapies are generally unnecessary for many working-age patients. However, some patients may need formal therapy with exercises if there are considerable impairments or a failure to progress after removal of the cast or splint. A few appointments for educational purposes for select patients are recommended. The numbers of appointments are dependent on the degree of debility, with one or two educational appointments appropriate for mildly affected patients. Patients with severe debility or those unable to return to work may necessitate 8 to 12 appointments that particularly include progressive strengthening exercises. Additionally, while routine use may be of limited benefit, those patients who have muscle weakness or other debilities may also derive benefit from therapy including self-training exercises, particularly if unable to return to work. Therefore, occupational or physical therapy is recommended for select patients.

Elbow Dislocations

Dislocation of the elbow generally occurs as a result of significant, high-force trauma, and only dislocation of the shoulder is more common clinically.(37) The most common mechanism is falling onto an outstretched hand, resulting in a posterior dislocation (98% of cases). Severe pain and inability to use the elbow and hand are typical presenting complaints. Accompanying fractures and vascular and neurological problems are common, and a combination of fracture and dislocation is called complex or complex instability.(405, 406) Radial head fractures are present approximately 10% of the time.(403) A combination of dislocation, radial head and ulnar coronoid process fractures is called the terrible triad injury.(402, 407-410)

Diagnostic Criteria

Dislocations are diagnosed based on a combination of typical inciting event (usually fall or trauma) combined with deformity and inability to use the arm. Persistent dislocation involves a complete inability to use the arm and deformity. Those that spontaneously reduced are usually accompanied by ongoing, though reduced pain and may have hemarthrosis.

Special Studies and Diagnostic and Treatment Considerations

X-Rays

Recommendation: X-rays for Elbow Dislocation
X-rays that include at least two to three views are recommended for elbow dislocation to rule-out fractures. Repeat x-rays after reduction are also recommended.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality studies evaluating x-rays for elbow dislocations. However, x-rays are used to rule-out fractures which are found approximately 10% of the time. Additionally, post-reduction x-rays are recommended. Thus, they are recommended to eliminate concomitant diagnoses of elbow fractures.

Initial Care

There are no quality studies for evaluation or treatment of dislocated elbows. An evaluation of the motor, sensory, and vascular system is required to rule-out accompanying injuries. Medical management of the dislocated elbow should include an x-ray to assure that there is no fracture. If the elbow remains dislocated, it should be reduced as soon as possible by a health care professional experienced in joint relocation. Injection of an anesthetic into the swollen joint space may help. The longer the elbow remains dislocated, the higher the probability that general anesthesia will be required to successfully reduce the elbow. Post-reduction x-rays are necessary, as well as an exam to be sure that the reduction is successful and that there is no loose body present. A posterior splint is to be applied for 10 days. Range-of-motion exercises are recommended after immobilization. Range-of-motion exercises should primarily involve the elbow, but should also include the shoulder (to prevent frozen shoulder), and the wrist.

Monitoring Progress

Patients should be re-evaluated 7 to 10 days after reduction. Range-of-motion exercises should be progressed at that point. If there is failure to progress, additional testing is indicated, including for ruling out fracture.

Activity Modification and Exercise

Most patients with a dislocated elbow are treated with a posterior splint after reduction. They usually are instructed to perform gentle range of motion exercises a few times a day to prevent prolonged rehabilitation to regain normal range of motion after the splint is removed. In addition, interventions are provided to address modifications to performance of ADLs and IADLs.

Medications

NSAIDs and Acetaminophen

Some patients with dislocations have been treated with NSAIDs and acetaminophen.

Recommendation: NSAIDs and Acetaminophen for Elbow Dislocation
NSAIDs and acetaminophen are recommended for treatment of pain from elbow dislocations.
Indications – Most patients with elbow dislocation requiring medication for pain control may be candidates. Patients at high risk for gastrointestinal bleeding may be better candidates for treatment with acetaminophen or a COX-2 inhibitor (see Hip and Groin Disorders chapter).

Frequency/Dose – As needed dosing is often sufficient. Most patients require a few days treatment and then generally have insufficient pain for further treatment.

Indications for Discontinuation – Resolution of pain, of development of adverse effects.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There is no quality evidence for use of NSAIDs for treatment of patients with elbow dislocation; however, they address pain management. NSAIDs are not invasive, have low adverse effects, and are low cost. Thus, they are recommended.

Evidence for the Use of NSAIDs and Acetaminophen for Elbow Dislocation
There are no quality studies evaluating the use of NSAIDs and acetaminophen for elbow dislocation.

Opioids
Some patients with dislocations have been treated with opioids.

Recommendation: Opioids for Select Patients with Elbow Dislocations
Opioids are recommended for treatment of select patients with pain from elbow dislocations.

Indications – Select patients with severe pain from elbow dislocation with insufficient control from other means, including acetaminophen and NSAIDs or with contraindications for NSAIDs. Considerable cautions are recommended concerning opioids and minimum numbers of doses should be prescribed as duration of treatment for elbow dislocations is usually quite limited.

Frequency/Dose – As needed dosing. Among the few patients requiring opioids, most require at most a few days treatment and then generally have insufficient pain for further treatment with opioids.

Indications for Discontinuation – Resolution of pain sufficiently to not require opioids, consumption that does not follow prescription instructions, adverse effects.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
Most patients do not require opioids. Some patients, particularly with more severe dislocations may require opioids. There is no quality evidence for use of opioids for treatment of these patients; however, they address pain management. There are major concerns regarding adverse effects of opioids including mortality. However, it is presumed that few doses combined with short-term use provides sufficient margin of safety for these medications. Opioids are not invasive, are low cost, but have high adverse effect profiles. They are recommended for limited duration use in select patients with elbow dislocations.

Evidence for the Use of Opioids for Elbow Dislocation
There are no quality studies evaluating the use of opioids for elbow dislocation.

Physical Methods/Rehabilitation

Splints and Slings
Posterior splints and a sling are used after reduction of a dislocated elbow.

Recommendation: Posterior Elbow Splint and Sling for Dislocated Elbow
Posterior elbow splint and slings are recommended for treatment of dislocated elbows.

Indications – Dislocated elbows after reduction.

Duration- Posterior splints are usually applied for approximately 10-17 days.(411) Range of motion exercises are recommended after immobilization. (An RCT in a foreign language reported early mobilization was superior to plaster immobilization for pure posterior dislocations.(412))

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There is one moderate-quality trial that suggests immobilization results in comparable outcomes to surgery for simple dislocations.(411) A posterior splint has been used for treatment of these dislocations and is to be applied for approximately 10 to 17 days. Range-of-motion exercises are recommended after immobilization. Splints are not invasive, have low adverse effects, are low to moderate cost, and are recommended.

Injections
Some patients with dislocations have been treated with anesthetic intraarticular injection(s) either pre-reduction or post-reduction for pain control.

Recommendation: Anesthetic Intraarticular Injections for Pre- or Post-Reduction Pain

Anesthetic, with or without opioid, intraarticular injection(s) are recommended either pre-reduction or post-reduction for pain management.

Indications – Either pre-reduction to assist with pain control and facilitate reduction or post-reduction for pain control.

Frequency/Dose – Short or intermediate acting injectable anesthetics are recommended. Generally only one injection is necessary, usually approximately 5 to 10mL. In some cases, a second may be reasonable.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation

There are no quality trials. Most patients do not require intraarticular anesthetic injections. Some require these injections to assist with obtaining sufficient pain relief to facilitate reduction and thus avoid general anesthesia. Some require these injections after reduction for pain control. Generally, pre-reduction injections utilize more short-term anesthetics and post-reduction injections utilize longer lasting anesthetics. These injections are invasive, have modest adverse effects and are moderately costly, but are recommended to facilitate reduction and/or pain control.

Evidence for the Use of Opioid Anesthetic Intraarticular Injections

There are no quality studies evaluating the use of opioid anesthetic intraarticular injections for pre- or post-reduction pain.

Surgery

Some patients require general anesthesia to facilitate reduction of a dislocated elbow. Surgery may also be required to repair ligaments if there is either sufficient laxity that recurrent dislocations occur or are otherwise unstable. (153)

1. *Recommendation: General Anesthesia to Facilitate Reduction in Select Patients*
   General anesthesia is recommended to facilitate reduction in select patients.

   Indications – Failure to obtain reduction, generally including use of intraarticular anesthetic injection.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation

There are no quality trials addressing the use of general anesthesia to facilitate reduction of a dislocated elbow. Most patients do not require general anesthesia to obtain sufficient muscular relaxation for reduction. In cases where reduction is not obtained and intraarticular injection with anesthetics is insufficient to obtain reduction, general anesthesia is used. General anesthesia is at least modestly invasive, has adverse effects and is high cost, however, it is recommended when other measures fail.

2. *Recommendation: Surgery for Elbow Joints that Recurrently Dislocate or are Unstable after Dislocation*
   Surgery is recommended to repair elbow joints that either recurrently dislocate or are otherwise unstable after dislocation(s).

   Indications – Recurrent elbow dislocations and/or unstable elbows after dislocation(s).

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation

There are no quality trials addressing surgery for dislocated elbow joints. Most patients do not require surgical repair after elbow dislocation. However, some have unstable joints due to ligament and/or capsular damage and laxity. Others have recurrent dislocations. Surgical repair is successful in some to improve or resolve these issues. Surgery is invasive, has adverse effects, is costly but is recommended for select patients.

Evidence for the Use of Immobilization and Surgery

There is 1 moderate-quality RCT incorporated into this analysis.

Elbow Lacerations

See Hand, Wrist, and Forearm Disorders chapter.

Elbow Sprains

An isolated elbow sprain is relatively uncommon and is caused by a significant high-force trauma, resulting in a disruption of ligament(s) about the elbow. The most common mechanism is a fall. Generally, a sprain is accompanied by other problems such as fracture, dislocation, or contusion. These potential complications need to be evaluated including the motor, sensory, and vascular systems. For the medical management of dislocation of the elbow, an x-ray should be taken to assure that there is no fracture.

Diagnostic Criteria

Sprains are diagnosed based on a combination of typical inciting event (usually fall or high-force trauma) combined with characteristic elbow pain and focal tenderness over ligament(s). In contrast with dislocations and fractures, sprains generally have normal, though painful range of motion.

Special Studies and Diagnostic and Treatment Considerations

X-Rays

Recommendation: X-rays for Elbow Sprain
X-rays that include at least two to three views are recommended to rule-out fractures. Repeat x-rays are also recommended if there is failure to improve as clinically expected over approximately a week.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendations
There are no quality studies evaluating x-rays for elbow sprains. However, x-rays are used to rule-out fractures which are found in a minority of patients. Thus, they are recommended to eliminate concomitant diagnoses of elbow fractures.

Initial Care

There are no quality studies for evaluation or treatment of elbow sprains. An evaluation of the motor, sensory, and vascular system is required to rule-out accompanying injury(ies). Other than mild sprains, medical management of the sprained elbow should generally include an x-ray to assure that there is no fracture.

Monitoring Progress

Patients should be re-evaluated 7 to 10 days after initial evaluation to assure there is progress. If there is a lack of progress, x-ray and re-evaluation is required.

Activity Modification and Exercise

Patients are usually instructed to perform gentle range-of-motion exercises a few times a day in order to maintain normal range of motion. In addition, interventions are provided to address modifications to performance of ADLs and IADLs.

Medications

NSAIDS AND ACETAMINOPHEN

Most patients with sprains have been treated with NSAIDs and acetaminophen.

Recommendation: NSAIDs and Acetaminophen for Elbow Sprains
NSAIDs and acetaminophen are recommended for the treatment of pain from elbow sprains.

Indications – Most patients with elbow sprain requiring medication for pain control may be candidates. Patients at high risk for gastrointestinal bleeding may be better candidates for treatment with acetaminophen or a COX-2 inhibitor (see Hip and Groin Disorders chapter).

Frequency/Dose – As needed dosing is often sufficient. Most patients require a short course of treatment and then generally have insufficient pain for further treatment.

Indications for Discontinuation – Resolution of pain, of development of adverse effects.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There is no quality evidence for use of NSAIDs for treatment of patients with elbow sprains; however, they address pain management. NSAIDs are not invasive, have low adverse effects, are low cost and are thus recommended.

Evidence for the Use of NSAIDs and Acetaminophen for Elbow Sprains
There are no quality studies evaluating the use of NSAIDs and acetaminophen for patients with elbow sprains.

OPIOIDS
Some patients with sprains have been treated for pain with opioids.
Recommendation: Opioids for Select Patients with Elbow Sprains
Opioids are recommended for the treatment of select patients with pain from severe elbow sprains.

Indications – Select patients with severe pain from severe elbow sprains with insufficient control from other means, including acetaminophen and NSAIDs or with contraindications for NSAIDs. Considerable cautions are recommended concerning opioids and minimum numbers of doses should be prescribed as duration of treatment for elbow sprains is usually limited.

Frequency/Dose – As needed dosing. Among the few patients requiring opioids, most require at most a few days treatment and then generally have insufficient pain for further treatment with opioids.

Indications for Discontinuation – Resolution of pain sufficiently to not require opioids, consumption that does not follow prescription instructions, adverse effects.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
Most patients do not require opioids. Some patients, particularly with more severe sprains may require opioids. There is no quality evidence for use of opioids for treatment of these patients, however they address pain management. There are major concerns regarding adverse effects of opioids including mortality. However, it is presumed that few doses combined with short term use provides sufficient margin of safety for these medications. Opioids are not invasive, are low cost, but have high adverse effect profiles. They are recommended for limited duration use in select patients with elbow sprains.

Evidence for the Use of Opioids for Elbow Sprains
There are no quality studies evaluating the use of opioids for patients with elbow sprains.

Physical Methods/Rehabilitation

SLINGS
Slings are often used for treating elbow sprains.

Recommendation: Slings for Elbow Sprains
Slings are recommended for the treatment of elbow sprains.

Duration- Generally should be used for less than 7 to 10 days with gradual reduction in use. Range of motion exercises of the elbow and shoulder are recommended several times daily while using a sling to prevent after complications from reduced ranges of motion.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation

There are no quality trials. Slings have been used to treat elbow sprains. Prolonged sling use is believed to result in reduced ranges of motion and other complications such as adhesive capsulitis. Range-of-motion exercises are recommended while using a sling for a sprain. Slings are not invasive, have low adverse effects, are low to moderate cost, and are recommended.

Evidence for the Use of Slings for Elbow Sprains
There are no quality studies evaluating the use of slings for elbow sprains.

Biceps Tendinosis (or Tendinitis) and Tears/Ruptures

Biceps tendinosis (or tendinitis) is a true muscle strain involving the muscle-tendon junction of the biceps brachii.(378, 413) (see Shoulder Disorders Guideline for bicipital tendinitis and ruptures at the shoulder). It typically occurs in the setting of the use of high force, particularly if unaccustomed.(378, 414) Symptoms are non-radiating pain in the muscle-tendon junction and there are generally no paraesthesias.(415) Pain limited weakness is a common complaint. While frequently considered two discrete entities of tendinosis vs. rupture, there is considerable overlap ranging from mild to moderate to severe ruptures. The greater the degree of rupture, the greater the likelihood surgery may be needed to attempt to restore the greatest degree of function, particularly in working age patients. The overall quality of evidence has been notably poor.(415, 416)

Diagnostic Criteria

Biceps tendinosis is diagnosed based on a combination of typical inciting event (usually high force exertion such as maximal lift, or unaccustomed stereotypical high force use) combined with characteristic localized elbow pain to the affected myotendinous junctions as they insert in the distal biceps' tendon in the distal upper arm. Focal tenderness is present over the affected, disrupted junctions. Ecchymosis may be present and is generally proportionate to the degree of tear of the junctions and/or rupture. Biceps ruptures involve a larger degree of tear of the myotendinous junctions up to, and including a complete rupture of one half or, rarely, both of the biceps brachii. These ruptures have a greater degree of associated weakness for elbow flexion. The physical examination also includes palpable abnormalities sometimes described as a "ropey" feeling biceps in the area of the insertion. An accompanying hematoma is often present.

Special Studies and Diagnostic and Treatment Considerations

X-Rays

X-rays are sometimes used to evaluate patients with biceps tendinosis and tears, although MRI and ultrasound are more commonly utilized.

Recommendation: X-rays for Biceps Tendinosis or Ruptures
X-rays are recommended for biceps tendinosis or ruptures.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
X-rays are not the first imaging study for consideration, as MRI or ultrasound is generally preferable. However, x-rays are particularly warranted if there is an acute traumatic event to help rule-out fracture. X-rays are not invasive, have low adverse effects, and are low cost. Therefore, they are recommended.

MRI

Magnetic resonance imaging (MRI) is often used to evaluate patients with biceps tendinosis and tears. (417)

Recommendation: MRI for Biceps Tendinosis or Ruptures
MRI is recommended for biceps tendinosis or ruptures.

Indications – Patients with moderate to severe biceps tendinosis or ruptures, particularly in whom the need for surgery is uncertain. Patients with complete ruptures generally do not require MRI as it usually does not alter the need for surgery. Patients with mild tears generally do not require MRI as the test does not alter the treatment plan and the good prognosis.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
MRIs are likely the most common imaging study to evaluate the degree of rupture. MRIs may assist in evaluating the need for surgery particularly in those patients with moderately severe tears in whom the degree of rupture may help identify whether surgery is likely to be beneficial. MRIs are not invasive, have low adverse effects, and are high cost. Therefore, they are recommended.

Ultrasound
Ultrasound has been used to evaluate patients with biceps tendinosis and tears.

Recommendation: Diagnostic Ultrasound for Biceps Tendinosis or Ruptures
Diagnostic ultrasound is recommended for the evaluation and diagnosis of biceps tendinosis or ruptures.

Indications – Patients with moderate to severe biceps tendinosis or ruptures, particularly those for whom the need for surgery is uncertain. Patients with complete ruptures generally do not require diagnostic ultrasound as it usually does not alter the need for surgery. Patients with mild tears generally do not require ultrasound as the test does not alter the treatment plan and the good prognosis. Ultrasound should generally not be performed in addition to MRI as it usually does not add additional information of benefit.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
After MRI, diagnostic ultrasound is likely the second most common imaging study to evaluate the degree of biceps tendinosis or rupture. Ultrasound may assist in evaluating the need for surgery particularly in those patients with moderately severe tears in whom the degree of rupture may help identify whether surgery is likely to be beneficial. Ultrasound is not invasive, has low adverse effects, and is moderate cost. Therefore, it is recommended.

Initial Care
There are no quality studies for evaluation or treatment of biceps tendinosis or tears. Patients with severe or complete ruptures should be referred to a surgeon to evaluate the need for surgical repair. Other patients should receive treatment including activity limitations and pain management strategies generally centering on NSAIDs.

Monitoring Progress
Patients should be re-evaluated approximately every 7 to 14 days to evaluate progress. If there is a lack of progress, diagnostic testing (see above) and/or referral for potential surgical repair should be considered.

Activity Modification and Exercise
Patients are often instructed to perform gentle range-of-motion exercises within pain-free range a few times a day to maintain as normal a range of motion during healing as practical. Excessive stretching however should generally be avoided during the acute healing phase. Heavy or moderately heavy forceful use should also be avoided in the acute healing phase. In addition, interventions are provided to address modifications to performance of ADLs and IADLs.

Medications

NSAIDs and Acetaminophen
Most patients with biceps tendinosis have been treated with NSAIDs and acetaminophen.

Recommendation: NSAIDs and Acetaminophen for Biceps Tendinosis and Tears
NSAIDs and acetaminophen are recommended for the treatment of pain from biceps tendinosis and tears.

Indications – Most patients with biceps tendinosis and tears require pain medication for pain control and most are likely candidates for treatment with NSAIDs. Patients at high risk for gastrointestinal bleeding may be better candidates for treatment with acetaminophen or a COX-2 inhibitor. (See Hip and Groin Disorders chapter).

Frequency/Dose – Dosing per manufacturer's recommendation. Many patients have sufficient pain that scheduled dosing is recommended in the acute healing phase. As-needed dosing may be sufficient for mild cases or those with less pain.

Indications for Discontinuation – Resolution of pain, of development of adverse effects.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation

There is no quality evidence for use of NSAIDs for treatment of these patients, however they address pain management. NSAIDs are not invasive, have low adverse effects, are low cost and are thus recommended.

Evidence for the Use of NSAIDs and Acetaminophen for Biceps Tendinosis and Tears

There are no quality studies evaluating the use of NSAIDs and acetaminophen for biceps tendinosis and tears.

Opioids

Some patients with biceps tendinosis and ruptures have been treated with opioids, particularly post-operatively.

Recommendation: Opioids for Select Patients with Biceps Tendinosis

Opioids are recommended for treatment of select patients with pain from moderately severe to severe biceps tendinosis or ruptures, particularly with nocturnal sleep disruption. Post-operative patients are also candidates.

Indications – Select patients with severe pain from moderately severe to severe biceps tendinosis and ruptures with insufficient control from other means, including acetaminophen and NSAIDs or with contraindications for NSAIDs. Post-operative patients are candidates. Considerable cautions are recommended concerning opioids and minimum numbers of doses should be prescribed as duration of treatment for elbow sprains is usually limited.

Frequency/Dose – As needed dosing with generally nocturnal dosing preferred for many patients. Post-operative patients may require scheduled dosing for the first few post-operative days. Most non-operative patients should be weaned off opioids within 7 to 10 days after the event.

Indications for Discontinuation – Resolution of pain sufficiently to not require opioids, consumption that does not follow prescription instructions, adverse effects.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation

Many patients will require a few days of treatment with opioids in the acute post-operative period, while non-operative patients do not generally require opioids. Patients with moderately severe to severe biceps tendinosis or inadequate control with NSAIDs may require opioids. There is no quality evidence for use of opioids for treatment of these patients, however they address pain management. There are major concerns regarding adverse effects of opioids including mortality. However, it is presumed that few doses combined with short term use provides sufficient margin of safety for these medications. Opioids are not invasive, are low cost, but have high adverse effect profiles. They are recommended for limited duration use in select patients.

Evidence for the Use of Opioids for Biceps Tendinosis

There are no quality studies evaluating the use of opioids for patients with biceps tendinosis or ruptures.

Physical Methods/Rehabilitation

Slings and Splints

Slings are often used for treating biceps tendinosis patients and post-operative patients. Post-operative patients are commonly treated with posterior splints.(416)

Recommendation: Slings and Splints for Biceps Tendinosis, Ruptures and Post-operative Patients

Slings and splints are recommended for the treatment of biceps tendinosis, ruptures, and post-operative patients.

Indications – Moderate to severely affected patients, especially for the first week. Post-operative patients also usually treated with posterior splints for approximately 2 weeks (range 1 to 6 weeks).(413, 416)

Duration- Generally should be used for less than 7 to 10 days with gradual reduction in use. Range of motion exercises of the elbow and shoulder are recommended several times daily for non-operative patients while using a sling or splint to prevent after complications from reduced ranges of motion. Operative patients require rest prior to resumption of exercises.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality trials. Slings and splints have been used to treat biceps tendinosis and ruptures. Prolonged use is believed to result in reduced ranges of motion and other complications such as adhesive capsulitis. Range-of-motion exercises are recommended while using a sling or splint. Slings and splints are not invasive, have low adverse effects, are low to moderate cost, and are recommended.

EXERCISES
Exercises are commonly prescribed to rehabilitate non-operatively treated biceps tendinosis and ruptures, as well as post-operative patients.(418)

Recommendation: Exercises for Biceps Tendinosis, Ruptures, or Post-operative Patients
Range-of-motion transitioning to strengthening exercises is recommended for treatment of biceps tendinosis, ruptures and post-operative patients.

Indications – All biceps tendinosis patients are candidates.

Frequency/Dose – Patients require individualized treatment plans based on pre-injury conditioning, injury severity, stage and progress. Generally, exercises begin with gentle stretching and progress to strengthening. Many, if not most patients require formal therapy. Mildly affected patients may recover sufficiently with fewer appointments. Two to three appointments per week for 4 to 6 weeks may be needed for more severely affected patients, followed by weekly appointments for another 4 to 6 weeks. Mildly affected patients who require supervised therapy may require as few as two or three appointments to institute a home exercise program that is gradually progressed.

Duration – Varies widely depending on severity, preinjury conditioning and job demands. Generally requires at least 2 to 3 weeks of supervision, with more severely affected patients, patients with high job physical demands and post-operative patients requiring up to 3 months.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality trials that evaluate exercises to rehabilitate non-operatively treated biceps tendinosis and ruptures. Exercises are believed to be critical for rehabilitation of these injuries. Transitioning from stretching to strengthening is required. Supervised therapy is often needed for more severely affected patients and post-operative patients. Workers with high job physical demands also frequently require supervised therapy to help assist with achieving an appropriate level of capacity prior to attempting return to high job demands. Exercises are not invasive and have low adverse effects. Costs range from low to high depending on numbers of appointments required. Exercise is recommended.

Surgery
Biceps tendinosis may be severe enough to involve a biceps rupture.(419) These recommendations are for a distal biceps tendon rupture, not a (proximal) bicipital tendon rupture, which occurs in the bicipital groove at the shoulder and often does not require surgery.) Distal biceps tendon ruptures can be managed non-operatively(420) and some authors note non-operative management continues to be acceptable for some, particularly if there are low job demands or older patients.(416, 421, 422) However, distal biceps ruptures generally occur in the setting of supramaximal use of force and requires surgical repair in most employed patients.(378, 416, 418, 419, 423, 424) A criterion of 50% rupture for surgical repair has been proposed.(422) Operative approaches include single-incision, dual-incision, and endoscopic.(413, 416)
Recommendation: Surgical Repair for Distal Biceps Ruptures
Surgical repair of distal biceps ruptures is recommended.

Indications – Biceps tendon ruptures that are either complete, large or in select patients with moderately severe biceps tendinosis patients who fail to adequately progress with non-operative care with which they have demonstrated compliance. Patients with high job physical demands but only moderate tears are also candidates for surgery to attempt to regain sufficient function to return to those job tasks.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
Quality studies are not available on surgery for biceps ruptures. There are multiple reconstruction procedures involving local repair, autografts and allografts.(421, 425-429) There is some evidence suggesting higher surgical complication rates among those over 3 to 12 weeks post-rupture.(428, 430-436) There is not quality evidence of benefits due to the low incidence and severity of these issues.(421) However, while surgery is high cost, invasive, and has some potential for adverse effects, outcomes appear much better with surgery as this muscle is the main forearm flexor. Thus, while there is insufficient evidence, surgery for a ruptured biceps is recommended.

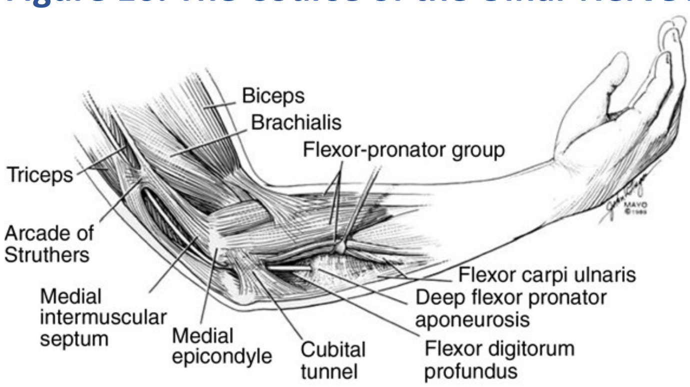
Triceps Tendinosis (or Tendinitis) and Tears/Ruptures

Triceps tendinosis (or tendinitis) is a true muscle strain involving the muscle-tendon junction of the triceps. It is believed to be analogous to biceps tendinosis, including high force mechanism of injury.(378, 413, 414, 437, 438) There are no quality trials for treatment of this condition, thus treatment by analogy to biceps tendinoses and tears is recommended including surgical repairs (see above).(378, 413, 437, 438)

Ulnar Neuropathies at the Elbow Including Condylar Groove-Associated Ulnar Neuropathy and Cubital Tunnel Syndrome

Although it is possible to entrap a nerve at any point along its course, there are two common areas for entrapment of the ulnar nerve at the elbow.(439) The first is in the condylar groove, and the second begins immediately distal to the elbow joint in the true, anatomic cubital tunnel (see Figure 10. The Course of the Ulnar Nerve Across the Elbow).(439, 440) This tunnel commences as the ulnar nerve begins to traverse distally beneath the aponeurosis.(440-442) Most of the published literature does not distinguish between these types of ulnar neuropathy despite the improbability that the risk factors and treatments are the same (e.g., arthrosis would appear more likely to affect the condylar groove segment; muscle contraction could theoretically affect the cubital tunnel segment but not the condylar groove). This produces a substantial lack of clarity in the available evidence.

Figure 10. The Course of the Ulnar Nerve Across the Elbow



Note the 5 common sites of compression of the ulnar nerve: the arcade of Struthers, the medial intermuscular septum, the medial epicondyle, the cubital tunnel, and the deep flexor pronator aponeurosis. Reprinted by permission of Mayo Foundation for Medical Education and Research. All rights reserved.

Proper testing to localize the abnormality involves a nerve conduction study that includes at least stimulation above and below the elbow. (140) The role for the "inching technique" to isolate the location of the nerve conduction velocity decrement and infer the precise location of the entrapment, while recommended by the American Academy of Electrodiagnostic Medicine(140) and logical for its importance to treatment has not been delineated in quality interventional studies. (Cubital tunnel syndrome should theoretically be amenable to treatment with simple decompression. Ulnar neuropathies in the condylar groove should theoretically be less amenable to simple (aka "in situ") decompression.) Aside from surgical studies, there are no quality studies on which to rely for treatment of ulnar neuropathies, and there is little quality evidence of benefits of treatment options.

Diagnostic Criteria

The differential diagnosis for ulnar neuropathy at the elbow particularly includes ulnar neuropathy at the wrist, C8 cervical radiculopathies, and other neurological entrapments located between the spinal cord and ulnar nerve in the carpal canal including thoracic outlet syndrome, diabetic neuropathy, neuropathy from alcohol, other systemic neuropathies, stroke, other cerebrovascular events, and central nervous system tumors. Most other causes may be eliminated or the probability reduced by conducting a careful history, physical exam, or focused testing. Some have reported the vast majority of these patients have no apparent cause.(443)

Patients with a presumptive diagnosis of ulnar neuropathy at the elbow should have: 1) tingling or numbness in an ulnar nerve distribution, generally involving the small digit and ulnar half of the ring finger; and often have 2) symptoms that are provoked either nocturnally or with sustained elbow flexion. Patients with a confirmed diagnosis of ulnar neuropathy at the elbow should have both symptoms as with a presumptive diagnosis above, and a confirmatory electrodiagnostic study (EDS) interpreted as consistent with ulnar neuropathy at the elbow. To make a diagnosis of cubital tunnel syndrome requires inching technique to define the abnormality to the cubital tunnel (rather than in the condylar groove, or "funny bone").

Special Studies and Diagnostic and Treatment Considerations

Electrodiagnostic Studies

See text on diagnostic testing above, including AAEM Guidelines.

1. *Recommendation: Electromyography for Diagnosing Subacute or Chronic Peripheral Nerve Entrapments*
   Electrodiagnostic studies are recommended to assist in the diagnosis of subacute or chronic peripheral nerve entrapments including ulnar neuropathies, radial neuropathies and median neuropathies.

   Indications – Patients with subacute or chronic paresthesias with or without pain, particularly with unclear diagnosis. In addition to segmental analysis (e.g., above vs. below elbow conduction), patients with peripheral neuropathies in the elbow region should generally have inching technique performed to localize the entrapment which assists with clinical management.(140) It has been stated that most of these patients do not require these tests, rather initially require non-operative treatment.(444)

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

2. *Recommendation: EDS for Diagnosis and Pre-operative Assessment of Peripheral Nerve Entrapments*
   Quality EDS (see above) are recommended to assist in securing a firm diagnosis for those patients without a clear diagnosis. EDS are also recommended as one of two methods to attempt to objectively secure a diagnosis prior to surgical release.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

3. *Recommendation: EDS for Initial Evaluation of Patients Suspected of Having a Peripheral Nerve Entrapment*
   EDS is not recommended for initial evaluation of most patients as it does not change the management of the condition and other interventions are believed to be efficacious.

   Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Ultrasound and MRI

Ultrasound and MRI have been used for evaluation of the ulnar nerve. (445)

Recommendation: Diagnostic Ultrasound and MRI for Evaluation and Diagnosis of Ulnar Neuropathies at the Elbow
There is no recommendation for or against the use of diagnostic ultrasound and MRI for the evaluation and diagnosis of ulnar neuropathies at the elbow.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendation

There are no quality studies available demonstrating superiority of ultrasound or MRI over other available tests to evaluate and diagnose. Therefore, there is no recommendation for or against the use of ultrasound and MRI.

Initial Care

Initial care involves seeking potential causal factors that can be changed. This is believed to include hyperflexion of the elbow during sleep, work or avocational activities, (444, 446) as well as avoiding leaning on the elbow/nerve (see elbow splinting section below).

1. *Recommendation: Position of Elbows During Sleep*
   It is recommended that patients be taught to sleep with their elbows extended, rather than flexed.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There is no quality evidence evaluating the use of sleep postures to treat elbow nerve entrapment. However, hyperflexed elbow postures appear to prominently produce the symptoms and theoretically compress the ulnar nerve at the elbow (condylar groove or cubital tunnel segments), thus avoidance of these postures appears important. Teaching patients to change sleep posture requires some efforts and time for the patient to adjust. This intervention is not invasive, has low or no adverse effects, is not costly and is recommended.

2. *Recommendation: Elbow Posture During Work or Avocational Activities*
   Patients are recommended to avoid hyperflexed (>90º) elbow postures at work (or during avocational activities).(439, 440)

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There is no quality evidence. However, hyperflexed elbow postures appear to prominently produce the symptoms, thus avoidance of these postures appears important at both work or during hobbies or other activities. It is noteworthy that this appears to affect few patients as few jobs require hyperflexed elbow postures. This intervention may require application of workplace limitations. This intervention is not invasive, has low or no adverse effects, but could be costly if there is no accommodation for the workplace limitations available. Nevertheless, this intervention is recommended.

Monitoring Progress

The clinical evaluation and progress of patients is most commonly monitored qualitatively from appointment to appointment. Particularly, it is desirable to seek information regarding the degree to which symptoms are present and whether the patient believes there has been improvement. However, there are several instruments that may be utilized for monitoring the progress of workers. These include the DASH. VAS symptoms and pain scores may also be used. Functional status scores and Global Symptom Scores are also used, particularly in some research studies. Grip and pinch strength measures may be utilized; however, patients who have mild symptoms generally have normal grip strength. All of these questionnaires are subjective and strength measures are effort-dependent, although they attempt to provide a semi-quantitative measure that may help to gauge improvement over time.

Activity Modification and Exercise

Various exercise regimens have been utilized to treat patients with ulnar neuropathies at the elbow, most commonly tendon-gliding and nerve-gliding exercises. In addition, interventions are provided to address modifications to performance of ADLs and IADLs.

EXERCISES

1. *Recommendation: Exercises for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathy at the Elbow*
   There is no recommendation for or against the use of exercises for acute, subacute, or chronic ulnar neuropathy at the elbow.

   Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

2. *Recommendation: Exercises for Rehabilitation of Post-operative Ulnar Neuropathy at the Elbow Patients with Significant Deficits*
   Exercise is recommended for rehabilitation of patients with post-operative ulnar neuropathy at the elbow with significant deficits.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There is one moderate-quality trial,(444) however, it had methodological problems that may have resulted in a lack of clear evidence in favor of one treatment or another. By analogy, there also is not evidence of efficacy of exercises for treatment of CTS. Thus, it is unclear if there is an independent benefit from tendon-gliding exercises. However, exercise programs are not invasive, have few if any adverse effects, and are low cost if performed independently after receiving initial instructions. Exercise programs are thought to be highly helpful for rehabilitation of post-operative patients with significant deficits.

Evidence for the Use of Exercise for Ulnar Neuropathy at the Elbow
There is 1 moderate-quality RCT incorporated into this analysis. There is 1 low-quality RCT in Appendix 1.(447)
(Warwick 95)

Medications

NON-STEROIDAL ANTI-INFLAMMATORY DRUGS AND ACETAMINOPHEN

Nonsteroidal anti-inflammatory drugs (NSAIDs) have been used for treatment of ulnar neuropathies to address beliefs in inflammatory mechanisms or to manage associated pain. NSAIDs have also been used for treatment of CTS.(448-452) Acetaminophen and paracetamol are sometimes utilized to treat neuropathies, although their effects on cyclooxygenase activity are minimal, and they are not anti-inflammatory.

1. *Recommendation: NSAIDs and Acetaminophen for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathies at the Elbow*
   NSAIDs and acetaminophen are not recommended as a primary treatment for acute, subacute, or chronic ulnar neuropathies at the elbow.

   Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

2. *Recommendation: NSAIDs and Acetaminophen for Post-operative Management of Ulnar Neuropathy-related Pain*
   NSAIDs and acetaminophen are recommended for post-operative pain management of ulnar neuropathy-related pain.

   Indications – Patients having recently undergone ulnar neuropathy surgical release. Generally, treat for 2 to 6 weeks post-op unless complications occur.

   Frequency/Dose – See manufacturer's recommendations.

   Indications for Discontinuation – Resolution of pain, adverse effects, intolerance.

   Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendations
There are no quality trials that address treatment for ulnar neuropathies. However, there are quality trials for treatment of CTS. A moderate-quality trial found an NSAID ineffective for treatment of CTS(453) and other studies appear to also suggest lack of efficacy (see Hand, Wrist, and Forearm Disorders chapter), thus by analogy, NSAIDs for ulnar neuropathies at the elbow are generally not recommended. However, in patients thought to have an inflammatory mechanism, they may be indicated. NSAIDs are not invasive and have low adverse effects profiles, particularly when used for short courses in occupational populations. Generic or over-the-counter formulations are low cost. A short course of an over-the-counter NSAID may be reasonable for select patients; however, routine use of NSAIDs for treatment of ulnar neuropathies is not recommended. There is one high-quality study in post-operative CTS patients indicating that for post-operative pain management, naproxen is superior to acetaminophen, which in turn is superior to placebo.(454) NSAIDs and acetaminophen may also facilitate the rehabilitation process without the impairments associated with opioids. Thus, by analogy, NSAIDs and acetaminophen are recommended for post-operative pain management of patients with ulnar neuropathy.

GLUCOCORTICOSTEROIDS (AKA "STEROIDS")

Oral and Injections (condylar groove or cubital tunnel)

Glucocorticosteroids have been used for treatment of peripheral neuropathies, particularly CTS through both oral and injection routes.(453, 455-460) Although these medications are considered to be anti-inflammatory corticosteroids, absent an inflammatory arthropathy or infection, CTS also does not typically evidence inflammation. Thus, the exact mechanism of action is uncertain. Evidence indicates that carpal tunnel injections are superior to oral steroids for treatment of CTS.(458)

Recommendation: Glucocorticosteroids (Oral or Injections) for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathies at the Elbow

There is no recommendation for or against the use of oral or injections (condylar groove or cubital tunnel) of glucocorticosteroids for the treatment of acute, subacute, or chronic ulnar neuropathies at the elbow. There is no indication for injecting steroids into the cubital tunnel as is done for the carpal tunnel as there is no other structure than the ulnar nerve in the tunnel and steroid injection into the nerve may cause damage.

Strength of Evidence **– No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendation

There are no quality trials for treatment of patients with ulnar neuropathies at the elbow. Glucocorticosteroid injections combined with splinting have been used for treatment of "cubital tunnel syndrome" in a small trial of low quality that also did not appear to precisely define the location of the ulnar neuropathy and did not show additive benefit.(461) (Hong 96) The mechanisms for development of CTS are not analogous to the ulnar nerve at the elbow, thus there is no recommendation. Among patients thought to have an inflammatory mechanism, these are reasonable treatment options.

Evidence for the Use of Glucocorticosteroids for Ulnar Neuropathy at the Elbow

There is 1 low-quality RCT in Appendix 1.(461) (Hong 96)

OPIOIDS – ORAL, TRANSDERMAL, AND PARENTERAL (INCLUDES TRAMADOL)

Opioids have occasionally been used to treat pain for patients with ulnar neuropathies at the elbow. These medications have primarily been used for a few nights in the post-surgical timeframe (see Chronic Pain chapter for a detailed discussion of opioids and their management).

1. *Recommendation: Routine Use of Opioids for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathies*
   The routine use of opioids is not recommended for the treatment of acute, subacute, or chronic ulnar neuropathies at the elbow.

   Strength of Evidence **– Not Recommended, Insufficient Evidence (I)**

2. *Recommendation: Use of Opioids for Treatment of Select Post-operative Ulnar Neuropathy Patients*
   Limited use of opioids for a few days to a couple weeks is recommended for select patients who have undergone recent ulnar neuropathy surgery, particularly if complications have occurred.

   Indications – Select patients who have recently undergone ulnar nerve surgeries, usually transpositions and have intense pain (especially having insufficient pain relief with NSAIDs), or have encountered complications.

   Frequency/Dose – Limit use to a few days up to a few weeks; primary use nocturnal to achieve post-operative sleep. Longer term use is occasionally required for those with more significant complications.

   Indications for Discontinuation – Resolution of pain, adverse effects, intolerance.

   Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendations

There are no quality studies of opioids for treatment of ulnar neuropathy patients. Transposition patients have larger incisions and frequently require post-operative opioids for at least a few days, usually in addition to NSAIDs. Some require these medications for a longer time. Opioids are not invasive, but have very high dropout rates and otherwise high rates of adverse effects. They are moderate to high cost depending on duration of treatment (see Chronic Pain chapter) and are not recommended for routine use. Quality evidence for treatment of post-operative patients with opioids to control pain is absent, although moderate-quality evidence documents benefits of NSAIDs for that purpose in CTS patients. Some patients have insufficient pain relief with NSAIDs, thus judicious use of opioids may be helpful, particularly for nocturnal use. Opioids are recommended for brief, select use in post-operative patients with primary use at night to achieve sleep post-operatively.

Vitamins (Including Pyridoxine)

Treatment of neuropathies, especially CTS, with pyridoxine (Vitamin B_6) has been attempted(448, 462-465) as there has been some association between pyridoxine deficiencies and peripheral neuropathies, as well as reports of associations of deficiencies with CTS in some,(466) but not all studies.(467) Vitamin B_{12} has been reported as a successful treatment for stroke patients with CTS.(468)

1. *Recommendation: Use of Pyridoxine for Acute, Subacute, or Chronic Ulnar Neuropathies*
   Pyridoxine is not recommended for routine treatment of acute, subacute, or chronic ulnar neuropathies in patients without vitamin deficiencies.

   Strength of Evidence **– Not Recommended, Insufficient Evidence (I)**

2. *Recommendation: Use of Other Vitamins for Acute, Subacute, or Chronic Ulnar Neuropathies*
   There is no recommendation for or against the use of other vitamins for treatment of acute, subacute, or chronic ulnar neuropathies.

   Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendations
There are no quality trials for treatment of ulnar neuropathy patients, thus treatment of CTS is used by analogy. There are two quality studies that reviewed pyridoxine to treat CTS patients (see Hand, Wrist, and Forearm Disorders chapter). However, benefits have not been shown in the highest quality study.(463) The moderate-quality crossover trial reported improvements in symptoms in 7 patients; however, 3 patients did not receive the placebo although their symptoms scores on pyridoxine were lower than in a control period.(462) While vitamin B6 is relatively low risk and patients may use it without prescription, available evidence does not support its use for the routine treatment of CTS, thus it is not recommended for other neuropathies including ulnar neuropathies. However, it may be a reasonable treatment option among patients with presumptive pyridoxine deficiency (e.g., malnutrition, alcoholism, malabsorption, especially jejunal disorders such as sprue, etc.).

Topical Medications

Lidocaine Patches

Topical lidocaine patches have been increasingly used to treat numerous pain conditions through transdermal application of topical anesthetic.(469-471)

Recommendation: Lidocaine Patches for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathies
There is no recommendation for or against the use of lidocaine patches for treatment of acute, subacute, or chronic ulnar neuropathies with pain.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendation
Topical lidocaine has not been evaluated for treatment of ulnar neuropathy patients. It has been suggested to improve pain associated with CTS although the case diagnoses do not appear well substantiated in the available study as pain complaints as an overriding symptom among CTS patients raise concerns about alternate explanations for the symptoms.(470) In one moderate-quality study, lidocaine patches were suggested to be somewhat more effective than naproxen;(469) however, naproxen does not appear particularly effective for treatment of a peripheral neuropathy and the study had a number of weaknesses. In the other study, injection was comparable to the patch, yet injections are likely a more effective strategy than naproxen, thus this body of evidence somewhat conflicts. Lidocaine patches are not invasive and have low adverse effects although some patients may experience local reactions such as skin irritation, redness, pain, or sores. These patches are also moderately or even high cost over time. The neuropathy is at the elbow although symptoms are usually distant, resulting in problems with theoretical use of these patches and there is an absence of quality evidence for this treatment of ulnar neuropathy at the elbow, thus there is no recommendation.

Ketamine

Topically administered ketamine has been used in experimental models for hyperalgesia.(472) (Poyhia 06) It has also been used to treat neuropathic pain.(473) (Gammaitoni 00)

Recommendation: Ketamine for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathies
There is no recommendation for or against the use of topically administered ketamine for treatment of acute, subacute, or chronic ulnar neuropathies with pain.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendation
There is no evidence supporting efficacy of ketamine for ulnar neuropathies at the elbow and therefore, there is no recommendation for or against its use.

Physical Methods/Rehabilitation

Devices

Magnets
Treatment of hand, wrist and forearm MSDs and CTS with magnets(474) and pulsed magnetic field therapy(475) has been attempted to manage pain.

Recommendation: Magnets for Management of Pain from of Acute, Subacute, or Chronic Ulnar Neuropathies
The use of magnets is not recommended for the management of pain for acute, subacute, or chronic ulnar neuropathies.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality studies of ulnar neuropathies. Quality evidence suggests magnets are not efficacious for treating pain associated with CTS.(474) Magnets are not invasive, have no adverse effects, and are low cost, but other interventions have been shown effective. Thus, magnets are not recommended for treatment of ulnar neuropathies.

Elbow Splinting

Elbow splinting has been used for treatment of ulnar neuropathies at the elbow, particularly nocturnal splinting or bracing.(440, 444, 446, 476)

Recommendation: Nocturnal Elbow Splinting for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathies
Nocturnal elbow splinting or bracing is recommended for treatment of acute, subacute, or chronic ulnar neuropathies at the elbow.(440, 444, 446, 476)

Indications – Symptoms consistent with ulnar neuropathy at the elbow, either condylar groove or cubital tunnel
Frequency/Dose – Elbow splints or braces are recommended to be worn while sleeping (range of 45-70 degrees used).(439, 444)

Indications for Discontinuation – Splints should be re-evaluated and potentially re-adjusted if no response within 2 weeks of starting treatment, particularly to assure that the patient is wearing them properly as well as to assess fit. If there is no improvement, splints should be discontinued and the accuracy of the diagnosis re-evaluated.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
Nocturnal elbow splints have been evaluated in one quality trial;(444) however, it had methodological problems that may have resulted in a lack of clear evidence in favor of one treatment or another. Nocturnal splints and braces are thought to be effective. They are not invasive, have minimal adverse effects, are low cost and are recommended.

Evidence for the Use of Nocturnal Elbow Splinting
There is 1 moderate-quality RCT incorporated into this analysis.

Allied Health Therapies

Acupuncture, Biofeedback, Manipulation and Mobilization, Massage, Soft Tissue Massage, Iontophoresis, Phonophoresis

Acupuncture, biofeedback, manipulation and mobilization, massage, soft tissue massage, iontophoresis, and phonophoresis have been used to treat many patients. There is evidence of its efficacy for several of these for treatment of chronic spine disorders (see Chronic Pain and Low Back Disorders chapters).

Recommendation: Acupuncture, Biofeedback, Manipulation and Mobilization, Massage, Soft Tissue Massage, Iontophoresis, and Phonophoresis for Acute, Subacute, or Chronic Ulnar Neuropathies at the Elbow
There is no recommendation for or against the use of acupuncture, biofeedback, manipulation and mobilization, massage, soft tissue massage, iontophoresis, and phonophoresis for the treatment of acute, subacute, or chronic ulnar neuropathies at the elbow.

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)**

Rationale for Recommendations
There are no quality studies evaluating the use of these treatments for ulnar neuropathies at the elbow and therefore, there is no recommendation for or against use of these treatments.

Low-Level Laser Therapy

Low level laser therapy has not been reported in a quality trial for treatment of ulnar neuropathy patients. Low-level laser treatment (LLLT) has been used to treat MSDs including CTS.(477, 478) It usually involves laser energy that does not induce significant heating (the theory is that the mechanism of action is through photoactivation of the oxidative chain).(479)

Recommendation: Low-Level Laser Therapy for Acute, Subacute, or Chronic Ulnar Neuropathies
Low-level laser therapy is not recommended for the treatment of acute, subacute, or chronic ulnar neuropathies.

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality trials for treatment of ulnar neuropathy patients. Trials for treatment of CTS suggest a lack of efficacy(480-482) (see Hand, Wrist, and Forearm Disorders chapter). Thus, low-level laser is not recommended for treatment of ulnar neuropathies.

Ultrasound

Ultrasound has been used to treat many MSDs including CTS.(480, 483, 484)

Recommendation: Ultrasound for Acute, Subacute, or Chronic Ulnar Neuropathies
Ultrasound is recommended for the treatment of acute, subacute, or chronic ulnar neuropathies.

Indications – Ulnar neuropathies that are sufficiently symptomatic to warrant treatment. Patients should generally be given nocturnal splints and had an inadequate response.

Frequency – The regimen in the highest quality study of CTS patients consisted of daily 15-minute sessions, 5 a week for 2 weeks, then twice a week for 5 more weeks; 1MHz with intensity 1.0W/cm^2, pulsed mode duty cycle of 1:4 and transducer area of 5cm^2.(484) Another successful regimen consisted of 15-minute sessions, 5 times a week for 3 weeks.(480)

Indications for Discontinuation – Resolution, failure to objectively improve or intolerance.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
There are no quality trials for treatment of patients with ulnar neuropathies. However, there are trials for treatment of CTS that suggest modest benefit(480, 483-486) (see Hand, Wrist, and Forearm Disorders chapter). Thus, by analogy, ultrasound is recommended for select patients who have failed treatment with a nocturnal brace/splint or obtained insufficient benefits.

Surgery

ULNAR NERVE SURGERIES (SIMPLE RELEASE, TRANSPOSITIONS, MEDIAL EPICONDYLECTOMY)

There are several surgical procedures for treatment of ulnar neuropathy at the elbow. Transposition of the ulnar nerve has been utilized for treatment of ulnar neuropathies at the elbow for more than 100 years.(487, 488) Various modifications of the surgical technique have been subsequently described.(489-502) (Caliandro 11) Subsequently, a simple decompression procedure has been developed for true cubital tunnel syndrome.(441, 503-507) Other procedures include medial epicondylectomy,(508) (Osterman 07) anterior submuscular transposition(509) and endoscopic approaches.(510)

The most common locations for compression of the ulnar nerve are reportedly:(511)

- Presence of epitrochleo-anconeus muscle 9 (14%)
- Adhesion to the medial epicondyle 25 (38%)
- Presence of a ligament of Struthers 4 (6%)
- Medical intermuscular septum 20 (30%)
- Other (scar, pannus, adhesion, lipoma, synovial cyst) 8 (12%)

Referral for surgery may be indicated for patients who have red flags of a serious nature (e.g., compressive neuropathy secondary to acute fracture), or have failed to respond to non-surgical management including elbow posture modifications. Surgical considerations depend on the confirmed diagnosis of the presenting symptoms. If surgery is a consideration, counseling regarding likely outcomes, risks, and benefits, and especially expectations is important. It is also important to set pre-operative expectations that there is a necessity to adhere to the rehabilitative exercise regimen and work through post-operative pain. In the post-operative phase, range-of-motion exercises should involve the elbow, as well as the wrist and shoulder to avoid frozen shoulder ("adhesive capsulitis"). If there is no clear indication for surgery, referring the patient to a provider experienced in non-operative treatment may aid in formulating a treatment plan.(512-515) (Mowlavi 00; Macadam 09; Ahcan 07; Assmus 11)

1. *Recommendation: Surgical Release for Treatment of Subacute or Chronic Ulnar Neuropathies*
   Surgical release is recommended for patients who fail non-operative treatment for subacute or chronic ulnar neuropathies or patients who have emergent or urgent indications (e.g., acute compression due to fracture, arthritides or compartment syndrome with unrelenting symptoms of nerve impairment).

   Indications – Symptoms of ulnar neuropathy at the elbow, and a significant loss of function, as reflected in significant activity limitations due to the nerve entrapment and that the patient has failed non-operative care usually for at least 3 months. Patients should generally have failed avoiding nerve irritation at night by preventing prolonged elbow flexion while sleeping, workstation changes to avoid elbow hyperflexion, full compliance in therapy, use of elbow pads, and removing opportunities to rest the elbow on the ulnar groove. Patients with severe symptoms such as continuous tingling and numbness, progression of symptoms or functional impairment may be earlier surgical candidates. Many surgeons will not operate on a patient without a positive electrodiagnostic study. Ideally, the EDS should include inching technique.(140) Conditions of inflammatory nature may take many months to heal and the timing of a surgical consultation referral should take into consideration the normal healing time. The type of surgical procedure selected is dependent on factors that include the preoperative EDS, surgeon's comfort and experience and surgical anatomy. Generally, a simple decompression is preferred over other procedures for true cubital tunnel syndrome.(511, 516)

   Strength of Evidence – **Recommended, Evidence (C)** – Simple (aka "in situ") decompression

   Strength of Evidence – **Recommended, Insufficient Evidence (I)** – Anterior subcutaneous transposition, medial epicondylectomy

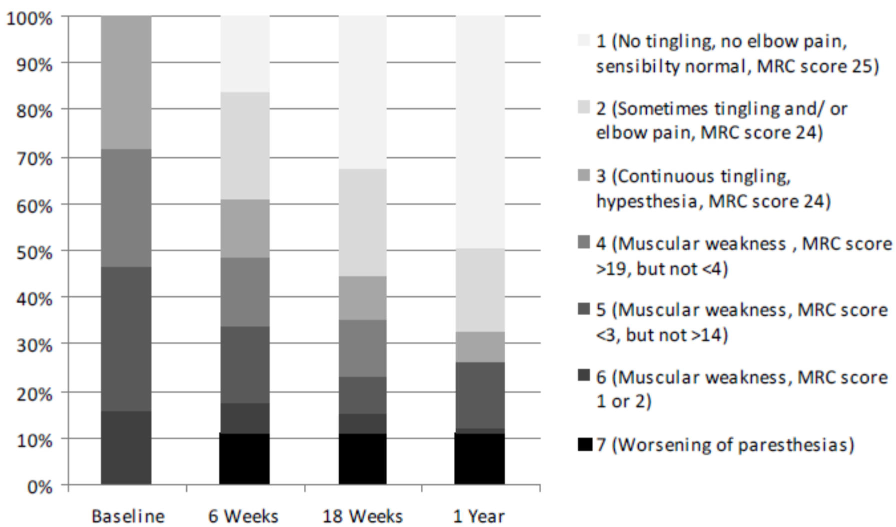
2. *Recommendation: Surgical Release for Treatment of Subacute or Chronic Ulnar Neuropathies*
   Anterior submuscular transposition is not recommended for the treatment of subacute or chronic ulnar neuropathies.

   Strength of Evidence – **Not Recommended, Insufficient Evidence (I)**

Rationale for Recommendations

There are no sham-controlled trials, trials with no treatment arms or a quality non-operative program. However, there are six moderate-quality trials, five of which compare surgical procedures and one of which compares surgery with botulinum injections.(356) Also, none of the studies distinguished between the different types of ulnar neuropathies at the elbow. Two studies(511, 516) compared simple decompression procedure with anterior subcutaneous transposition of the ulnar nerve; two studies(517, 518) compared simple decompression with submuscular transposition; and one study(443) compared medial epicondylectomy with anterior transposition. The simple ulnar nerve release does have some evidence of benefits over more complicated surgical procedures such as transposition, particularly concerning complications. Surgical options for this problem are invasive, have adverse effects and are high cost. Yet, in well defined cases as outlined above that include positive electrodiagnostic studies with objective evidence of loss of function, lack of improvement may necessitate surgery and surgery for this condition is recommended.

Figure 11. Pre-and Postoperative Grading and Number (%) of Simple Decompression and Anterior Subcutaneous Transposition Participants



Adapted from Bartels RHMA, Verhagen WIM, van der Wilt GJ, Meulstee J, van Rossum LGM, Grotenhuis JA. Prospective randomized controlled study comparing simple decompression versus anterior subcutaneous transposition for idiopathic neuropathy of the ulnar nerve at the elbow: Part 1. *Neurosurgery*. 2005;56(3):522-30.

Table 8. Complications[a]

	SD	AST	Total
Sensibility loss around scar[b]	2	14[b]	16
Superficial infection	2	6	8[c]
Deep infection	---	1	1
Elbow pain[c]	2	1[d]	3
Seroma	1	---	1
Dehiscence of wound	---	1	1
All	7	23	30

[a] SD, simple decompression; AST, anterior subcutaneous transposition.
[b] In one participant, the loss of sensibility had resolved within 3 months after surgery.
[c] After changing from intracutaneous closure of the wound with resolvable sutures to a running suture with a monofilamantous suture that was removed 10 days after surgery, only one superficial infection occurred.
[d] In one participant, a neuroma of a subcutaneous sensory nerve had to be excised. Afterward, the patient was pain free.

Bartels RHMA, Verhagen WIM, van der Wilt GJ, Meulstee J, van Rossum LGM, Grotenhuis JA. Prospective randomized controlled study comparing simple decompression versus anterior subcutaneous transposition for idiopathic neuropathy of the ulnar nerve at the elbow: Part 1. *Neurosurgery*. 2005;56(3):522-30. Reprinted with permission from Wolters Kluwer Health/Lippincott, Williams & Wilkins.

Evidence for the Use of Surgery for Ulnar Neuropathy
There are 5 moderate-quality RCTs incorporated into this analysis.

Radial Nerve Entrapment (Including Radial Tunnel Syndrome)

Radial nerve entrapment, particularly of the posterior interosseous branch of the radial nerve, causes proximal forearm aching and pain that persists despite presumably effective treatment.(446, 519-523) (Henry 06) It is clinically somewhat difficult to distinguish from non-specific forearm and elbow pain, is considered controversial,(524, 525) and it is sometimes referred to as "resistant tennis elbow" or "supinator syndrome." A relatively rare condition, radial nerve entrapment is estimated to be approximately 30 to 100 fold less common than carpal tunnel syndrome.(526) There are multiple sites for potential entrapment. Most commonly, these sites include the extensor carpi radialis brevis origin, fibrous bands overlying the radial head, radial recurrent arterial fan, and the arcade of Frohse at the entrance to the supinator muscle.(527, 528)

A confirmatory electrodiagnostic motor study is helpful (often difficult to obtain) and is recommended [**Recommended, Insufficient Evidence (I)]**. There are no quality studies on which to rely for the treatment of radial neuropathies and there is not evidence of benefits of the following treatment options. However, these options are low cost, have few adverse effects, and are not invasive. Thus, while there is insufficient evidence to support their use, they are recommended.

There are no quality trials for non-surgical treatments. Some of the reported treatments have included physical therapy and exercise,(446, 529) and glucocorticosteroid injections.(446) In the absence of quality evidence for treatment of these radiculopathies, it is recommended that the treatments for ulnar neuropathy at the elbow (summarized below) be used to infer treatment for radial neuropathies.

Exercises:

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)** – Acute, subacute, or chronic

Strength of Evidence – **Recommended, Insufficient Evidence (I) – Post-operative, or significant deficits**

NSAIDs and Acetaminophen:

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)** – Acute, subacute, or chronic

Strength of Evidence – **Recommended, Insufficient Evidence (I)** – Post-operative

Glucocorticosteroids – Oral or Injections:

Strength of Evidence **– No Recommendation, Insufficient Evidence (I)** – Acute, subacute, or chronic

Opioids – Oral, Transdermal, and Parenteral (includes Tramadol):

Strength of Evidence **– Not Recommended, Insufficient Evidence (I)** – Acute, subacute, or chronic

Strength of Evidence – **Recommended, Insufficient Evidence (I)** – Post-operative

Vitamins (Including Pyridoxine):

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)** – Pyridoxine – acute, subacute, or chronic

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)** – Other vitamins – acute, subacute, or chronic

Lidocaine Patches:

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)** –Acute, subacute, or chronic

Ketamine:

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)** – Acute, subacute, or chronic

Magnets:

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)** – Acute, subacute, or chronic

Elbow and Wrist Splinting:

Strength of Evidence – **Recommended, Insufficient Evidence (I)** – Acute, subacute, or chronic

Acupuncture, Biofeedback, Manipulation and Mobilization, Massage, Soft Tissue Massage, Iontophoresis, Phonophoresis:

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)** – Acute, subacute, or chronic

Low-Level Laser Therapy:

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)** – Acute, subacute, or chronic

Ultrasound:

Strength of Evidence – **Recommended, Insufficient Evidence (I)** – Acute, subacute, or chronic

Surgery

Radial Nerve Surgeries

Surgical release of the radial nerve has been performed.(522, 530-532) Referral for surgery may be indicated for patients who have red flags of a serious nature (e.g., compressive neuropathy secondary to acute fracture), or have failed to respond to non-surgical management including wrist splints. Surgical considerations depend on the confirmed diagnosis of the presenting symptoms. If surgery is a consideration, counseling regarding likely outcomes, risks, and benefits, and especially expectations is important. It is also important to set pre-operative expectations that there is a necessity to adhere to the rehabilitative exercise regimen and work through post-operative pain. In the post-operative phase, range-of-motion exercises should involve the elbow, as well as the wrist and shoulder to avoid frozen shoulder (“adhesive capsulitis”). If there is no clear indication for surgery, referring the patient to a provider experienced in non-operative treatment may aid in formulating a treatment plan.

Recommendation: Surgical Release for Treatment of Subacute or Chronic Radial Neuropathies
Surgical release is recommended for patients who fail non-operative treatment for subacute or chronic radial neuropathies or patients who have emergent or urgent indications (e.g., acute compression due to fracture, or compartment syndrome with unrelenting symptoms of nerve impairment).

Indications – Symptoms of radial neuropathy at the elbow, and a significant loss of function, as reflected in significant activity limitations due to the nerve entrapment and that the patient has failed non-operative care usually for at least 3 to 6 months. Patients should generally have failed wrist splints, avoidance of aggravating exposures, and full compliance in therapy. Patients with severe symptoms such as continuous tingling and numbness, progression of symptoms or functional impairment may be earlier surgical candidates. Many surgeons will not operate on a patient without a positive electrodiagnostic study. Ideally, the EDS should include inching technique. The type of surgical procedure selected is dependent on factors that include the preoperative electrodiagnostic studies, surgeon's comfort and experience and surgical anatomy.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation
Quality studies are not available on surgical treatment for radial nerve entrapment and there is not evidence of its benefits. If, after at least 3 to 6 months of conservative treatment, the patient fails to show signs of improvement, surgery may be a reasonable option if there is unequivocal evidence of radial neuropathy that includes positive electrodiagnostic studies and objective evidence of loss of function as outlined above. Surgical options are invasive, have adverse effects, and are high cost. Surgery is recommended for carefully selected patients.

Pronator Syndrome (Median Neuropathies in the Forearm)

Pronator syndrome involves median nerve entrapment under or within the pronator teres muscle in the proximal forearm.(446, 519, 533-535) It causes pain in the flexor forearm and paresthesias similar to carpal tunnel syndrome, which is the main consideration in the differential diagnosis. Pronator syndrome is believed to cause nocturnal awakening less frequently than carpal tunnel syndrome. A confirmatory electrodiagnostic study is helpful and is recommended [**Recommended, Insufficient Evidence (I)]**.

There are no quality trials for non-surgical treatments.(533) Some of the reported treatments have included avoiding aggravating activities,(446) rest,(536-538) NSAIDs, and glucocorticosteroid injections.(446, 536-538) (Neal 10) In the absence of quality evidence for treatment of these radiculopathies, it is recommended that the treatments for ulnar neuropathy at the elbow (summarized below) be used to infer treatment for median neuropathies (pronator syndrome) including:

Exercises:

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)** – Acute, subacute, or chronic

Strength of Evidence – **Recommended, Insufficient Evidence (I)** – Post-operative, or significant deficits

NSAIDs and Acetaminophen:

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)** – Acute, subacute, or chronic

Strength of Evidence – **Recommended, Insufficient Evidence (I)** – Post-operative

Glucocorticosteroids – Oral or Injections:

Strength of Evidence **– No Recommendation, Insufficient Evidence (I)** – Acute, subacute, or chronic

Opioids – Oral, Transdermal, and Parenteral (Includes Tramadol):

Strength of Evidence **– Not Recommended, Insufficient Evidence (I)** – Acute, subacute, or chronic

Strength of Evidence – **Recommended, Insufficient Evidence (I)** – Post-operative

Vitamins (Including Pyridoxine):

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)** – Pyridoxine; acute, subacute, or chronic

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)** – Other vitamins; acute, subacute, or chronic

Lidocaine Patches:

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)** – Acute, subacute, or chronic

Ketamine:

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)** – Acute, subacute, or chronic

Magnets:

Strength of Evidence – **Not Recommended, Insufficient Evidence (I)** – Acute, subacute, or chronic

Elbow Splinting:

Strength of Evidence – **Recommended, Insufficient Evidence (I)** – Acute, subacute, or chronic

Acupuncture, Biofeedback, Manipulation and Mobilization, Massage, Soft Tissue Massage, Iontophoresis, Phonophoresis:

Strength of Evidence – **No Recommendation, Insufficient Evidence (I)** – Acute, subacute, or chronic

Low-Level Laser Therapy:

Strength of Evidence – **Not Recommended, Insufficient Evidence (I) –** Acute, subacute, or chronic

Ultrasound:

Strength of Evidence – **Recommended, Insufficient Evidence (I)** – Acute, subacute, or chronic

Surgery

Median Nerve Surgeries

Surgical release of the median nerve for pronator syndrome has been performed.(537-539) Referral for surgery may be indicated for patients who have red flags of a serious nature (e.g., compressive neuropathy secondary to acute fracture), or have failed to respond to non-surgical management including wrist splints. Surgical considerations depend on the confirmed diagnosis of the presenting symptoms. If surgery is a consideration, counseling regarding likely outcomes, risks, and benefits, and especially expectations is important. It is also important to set pre-operative expectations that there is a necessity to adhere to the rehabilitative exercise regimen and work through post-operative pain. In the post-operative phase, range-of-motion exercises should involve the elbow, as well as the wrist and shoulder to avoid frozen shoulder ("adhesive capsulitis"). If there is no clear indication for surgery, referring the patient to a provider experienced in non-operative treatment may aid in formulating a treatment plan.

Recommendation: Surgical Release for Treatment of Subacute or Chronic Forearm Median Neuropathies, including Pronator Syndrome

Surgical release is recommended for patients who fail non-operative treatment for subacute or chronic median neuropathies in the forearm. It is also recommended for patients who have emergent or urgent indications (e.g., acute compression due to fracture, or compartment syndrome with unrelenting symptoms of nerve impairment).

Indications – Symptoms of median neuropathy in the forearm, and a significant loss of function, as reflected in significant activity limitations due to the nerve entrapment and that the patient has failed non-operative care usually for at least 3 to 6 months. Patients should generally have failed wrist splints, avoidance of aggravating exposures, and full compliance in therapy. Patients with severe symptoms such as continuous tingling and numbness, progression of symptoms or functional impairment may be earlier surgical candidates. Many surgeons will not operate on a patient without a positive electrodiagnostic study. Ideally, the EDS should include inching technique. The type of surgical procedure selected is dependent on factors that include the preoperative electrodiagnostic studies, surgeon's comfort and experience and surgical anatomy.

Strength of Evidence – **Recommended, Insufficient Evidence (I)**

Rationale for Recommendation

Quality studies are not available on surgical treatment for median nerve entrapment in the forearm including pronator syndrome, and there is not evidence of its benefits. If, after at least 3 to 6 months of conservative treatment, the patient fails to show signs of improvement, surgery may be a reasonable option if there is unequivocal evidence of median neuropathy that includes positive electrodiagnostic studies and objective evidence of loss of function as outlined above. Surgical options for this problem are invasive, have adverse effects and are high cost. Surgery is recommended for carefully selected patients.

Appendix 1: Low-quality Randomized Controlled Trials and Non-randomized Studies

The following low-quality randomized controlled studies (RCTs) and other non-randomized studies were reviewed by the Evidence-based Practice Elbow Panel to be all inclusive, but were not relied upon for purpose of developing this document's guidance on treatments because they were not of high quality due to one or more errors (e.g., lack of defined methodology, incomplete database searches, selective use of the studies and inadequate or incorrect interpretation of the studies' results, etc.), which may render the conclusions invalid. ACOEM's Methodology requires that only moderate- to high-quality literature be used in making recommendations.(540)

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