



# Cervical and Thoracic Spine Disorders

Effective Date: October 17, 2018

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## Table of Contents

Impact .....	6
Overview .....	6
Summary of Recommendations and Evidence.....	6
Basic Principles and Definitions .....	8
Initial Assessment.....	12
Red Flags .....	12
Absence of Red Flags .....	13
Cervical Pain .....	14
Thoracic Pain .....	14
Radicular Pain Syndromes.....	14
Zygapophysial (Facet) Joint Degenerative Joint Disease .....	15
Clinical Syndromes .....	15
Medical History and Physical Examination.....	16
Medical History.....	16
Physical Examination .....	17
Associated Factors, Risk Factors and Work-Relatedness .....	22
Individual Factors.....	23
Psychosocial and Work Organizational Factors .....	23
Job Physical Factors .....	23
Cervical Radiculopathy.....	24
Degenerative Cervical Spine Conditions .....	24
Thoracic Spine Pain.....	25
Follow-up Visits.....	25
Diagnostic Criteria .....	25
Diagnostic Tests.....	26
Roentgenograms (X-Rays).....	26
Magnetic Resonance Imaging (MRI) .....	28
Electromyography.....	31
Surface Electromyography.....	32
Discography .....	33
MRI Discography .....	35
Single Photon Emission Computed Tomography (SPECT).....	35
Functional Capacity Evaluations .....	36
Diagnostic Facet Blocks (Intra-Articular and Nerve Blocks) .....	38
Myeloscopy.....	38
Ultrasound (Diagnostic) .....	39
Thermography .....	39
Fluoroscopy.....	40
Videofluoroscopy.....	40
Initial Care .....	41
Education .....	41
Fear Avoidance Belief Training.....	43
Activity Modification and Exercise .....	44

Rest And Relative Rest .....	44
Sleep Pillows And Sleep Posture .....	45
Mattresses .....	46
Exercises .....	47
Aerobic Exercises .....	49
Directional Exercise.....	50
Stretching And Flexibility .....	50
Strengthening and Stabilization Exercises .....	51
Aquatic Therapy (Including Swimming) .....	52
Yoga .....	53
Medications.....	54
Non-steroidal Anti-inflammatory Drugs (NSAIDs) and Acetaminophen .....	54
Anti-Depressants.....	56
Anti-Epileptic Agents.....	58
Capsaicin, “Sports Creams” and Other Creams and Ointments.....	60
Lidocaine Patches .....	62
Colchicine.....	62
Systemic Glucocorticosteroids (AKA “Steroids”).....	63
Tumor Necrosis Factor- $\alpha$ LPHA Inhibitors.....	65
Skeletal Muscle Relaxants.....	65
Opioids – Oral, Transdermal, and Parenteral (Includes Tramadol).....	67
Complementary or Alternative Methods or Dietary Supplements, Etc. ....	75
Vitamins .....	76
Allied Health Professionals, Physical and Occupational Therapy, Chiropractic, etc.....	77
Devices .....	77
Magnets And Magnetic Stimulation .....	77
Iontophoresis.....	78
Physical Methods .....	79
Acupuncture .....	79
Cryotherapies.....	80
Heat Therapies.....	81
Manipulation And Mobilization .....	85
Manipulation Under Anesthesia (MUA) And Medication-Assisted Spinal Manipulation (MASM).....	89
Massage .....	90
Myofascial Release.....	91
Neuroreflexotherapy .....	92
Subcutaneous Carbon-dioxide Insufflations .....	92
Traction.....	93
Decompressive Devices .....	94
Electrical Therapies .....	94
Interferential Therapy.....	94
Microcurrent Electrical Stimulation .....	95
Transcutaneous Electrical Neurostimulation (TENS) And Neuromuscular Electrical Stimulation (NMES).....	95
Percutaneous Electrical Nerve Stimulation (Pens).....	97

High-Voltage Galvanic Therapy .....	97
Injection Therapies .....	97
Botulinum Injections .....	97
Cervical Epidural Injections .....	98
Radiofrequency Neurotomy, Neurotomy, And Facet Rhizotomy .....	99
Dorsal Root Ganglia Radiofrequency Lesioning .....	101
Facet Joint Hyaluronic Acid Injections .....	101
Intrathecal Drugs .....	102
Intradiscal Electrothermal Therapy (IDET) .....	102
Percutaneous Intradiscal Radiofrequency Thermocoagulation (PIRFT) .....	103
Prolotherapy Injections .....	103
Trigger Point Injections .....	104
Surgical Considerations .....	104
Cervical and Thoracic Nerve Root Decompression .....	105
Discectomy, Microdiscectomy, Sequestrectomy, Endoscopic Decompression .....	105
Decompressive Surgery For Spinal Stenosis (Laminoplasty, Laminectomy) .....	108
Spinal Fusion .....	109
Non-specific Chronic Cervical Pain: Cervical Fusions .....	112
Disc Replacement .....	113
Vertebroplasty .....	114
Kyphoplasty .....	115
Cervical Spinal Cord Stimulators .....	116
Rehabilitation for Delayed Recovery .....	117
References .....	118

## Impact

It is estimated that 14% to 71%(1) of the general population experience an episode of cervical pain at some point during their lifetime.(2-11) and pain recurrence is common.(12) The annual prevalence of cervical pain has been reported to be 30% to 50%.(13) The annual incidence of cervical pain ranged from 10.4% to 21.3%.(14) Cervical pain is usually self-limiting and there are many factors that influence outcomes in patients.(15) Out of the 291 conditions studied in Global Burden of Disease 2010 Study, neck pain was found to rank 21st in terms of overall burden and 4th in terms of overall disability.(16)

Cervical pain accounts for a large portion of direct and indirect costs to the health care system (17) resulting in a need to understand the condition's natural history and what interventions for treatment of these patients are beneficial. Prevention of neck and thoracic spine conditions are also addressed towards the end of this guideline.

## Overview

Recommendations for assessment and treatment of adults with cervical (neck) and thoracic (middle back) spine problems are presented in this clinical practice guideline. Compared with low back pain, there are relatively few quality trials evaluating cervical pain and still fewer that evaluate work-related cervical pain. Therefore, studies that include non-workers' compensation patients were used to develop these recommendations.<sup>i</sup> Industry-sponsored trials were also included.<sup>ii</sup> Most studies did not delineate specific diagnoses for cervical pain as a precise anatomic source for most cervical pain episodes is unknown. The lack of specific pathophysiological correlates has resulted in treatment classifications schemes that have been at least partially validated.(18, 19)

Topics include the initial assessment and diagnosis of patients with acute, subacute, and chronic cervical and thoracic pain problems that are potentially work-related, identification of red flags that may suggest the presence of a serious underlying medical condition, initial management, diagnostic considerations and special studies to identify clinical pathology, work-relatedness, modified duty and activity, and return to work, as well as further management considerations including delayed recovery. The majority of peer-reviewed literature categorizes pain as acute (<1 month duration), subacute (1 to 3 months duration), and chronic (>3 months duration). These definitions have been adopted throughout this document. In instances where a study used a different classification, those articles are grouped into one or more of these three categories for purposes of uniformity.

Algorithms for patient management are included. This guideline's master algorithm schematizes how practitioners may generally manage acute, subacute, or chronic cervical and thoracic spine disorders. The text, tables, and numbered algorithms all expand upon the master algorithm.

## Summary of Recommendations and Evidence

The following is a general summary of the recommendations contained in this guideline:

- The initial assessment of patients with cervical and thoracic spine problems focuses on detecting indications of potentially serious disease, termed "red flags" (i.e., fever, serious neurologic involvement, or major trauma).
- In the absence of red flags, imaging and other tests are not recommended in the first 4 to 6 weeks of cervical and thoracic spine symptoms, as it almost never results in a meaningful change in clinical management. Nonprescription medication or an appropriately selected nonsteroidal anti-inflammatory drug (NSAID), appropriate adjustment of physical activity if needed, and the use of thermal modalities such as heat and/or cryotherapies can safely relieve discomfort. Some utilize manipulation in this phase.

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<sup>i</sup>Many trials exclude workers' compensation patients. This necessitates relying on those trials for evidence-based guidance for injured workers. However, readers may infer results may differ between those with compared to those without compensation with most literature suggesting compensation imparts somewhat worse outcomes.

<sup>ii</sup>Many studies that focus on pharmaceuticals and specific devices are industry sponsored. Each study must be evaluated on its own merits, including those not sponsored by industry. In certain areas, this also may have made little difference as the comparisons were between the medication and placebo and the results may be stark. However, in other studies, comparison groups may have been suboptimally treated (e.g., a low-dose of ibuprofen) and produced a bias in favor of the medication or device. In addition, industry-sponsored studies have sometimes been shown to have better results and lower complication rates than studies conducted by independent investigators. In other situations, the industry-sponsored studies are superior and stand on their own merit.

- In the absence of red flags, health care professionals can effectively manage most cervical and thoracic spine problems conservatively.
- An early mechanical evaluation using repeated end-range test movements to determine the presence or absence of a directional preference and pain centralization has been suggested to guide directional exercise treatments that are associated with better outcomes, although the quality studies have only been done on the lower back.
- At the first visit, the physician or other health care provider should assure the patient that cervical and thoracic pain is common, has an excellent prognosis, and in most cases is not debilitating on a long-term basis. Patients with elevated fear avoidance beliefs may require additional instructions and interventions to be reassured of this prognosis. Patients with elevated fear avoidant beliefs are likely candidates for utilization of tools to measure the beliefs. Patients with significantly elevated beliefs, particularly combined with early failure to progress as expected, are considered candidates for early referral for allied health referrals to prevent conversion to a chronic pain syndrome (see Chronic Pain guideline).(20, 21) Theoretically, this reassurance has the potential to decrease the probability of the patient developing a chronic pain syndrome.
- To avoid undue weakness, atrophy, contractures, and debilitation from inactivity, some activity or job modification may be helpful in the acute period. However, bed rest is not recommended for essentially all cervical and thoracic pain and cervical radiculopathy patients other than those with unstable fractures or similar problems with pending neurological catastrophe. Maintaining ordinary activity, as tolerated, leads to the most rapid recovery.
- All patients should be encouraged to return to usual activities and work as soon as possible as evidence suggests this leads to the best outcomes for all spine disorders. This process may be facilitated with temporary modified (or alternative) duty for acute and subacute pain, particularly if job demands exceed patient symptom tolerance. Full-duty work is a reasonable option for patients with acute and subacute pain syndromes with low physical job demands and the ability to control such demands (e.g., alternate their posture) as well as for those with less severe presentations. Full duty work is appropriate for those with chronic neck and thoracic pain syndromes who do not have objective evidence that work would cause a significant risk of substantial harm that is imminent (American’s with Disabilities Act), with the patient deciding whether the rewards of work despite symptoms is worth the “cost” of the symptoms.
- Strengthening exercises have the best evidence of efficacy among the exercise regimens, whether for acute, subacute, or chronic cervical and thoracic pain patients. This contrasts with low back pain where aerobic exercise has the greatest evidence of efficacy.
- Non-specific stretching is not recommended as it is not helpful for treatment of cervical and thoracic pain. However, directional exercise and slump stretching exercises may be helpful. Strengthening exercises, including cervical stabilization exercises, are recommended, but not until the acute period of cervical and thoracic pain has subsided.
- There is evidence of efficacy for manipulation/mobilization in combination with exercise for treatment of non-specific neck pain for short-term pain relief and increased range of motion (ROM) compared to manipulation and/or mobilization alone or in combination.
- There is some evidence for efficacy of acupuncture in chronic pain patients.
- Many invasive and non-invasive therapies are intended to cure or manage pain, but no strong evidence exists that they accomplish this as successfully as therapies that focus on restoring functional ability without focusing on pain. In those cases, the traditional medical model of “curing” the patient does not work well. Furthermore, patients should be aware that returning to normal activities most often aids functional recovery.
- Patients should be encouraged to accept responsibility for managing their recovery rather than expecting the provider to provide an easy “cure.” This process will promote using activity rather than pain as a guide, and it will make the treatment goal of return to occupational and non-occupational activities more obvious.
- If symptoms persist without improvement, further evaluation is recommended.
- Within the first 3 months of cervical and thoracic spine symptoms, only patients with evidence of severe spinal disease or severe debilitating symptoms and physiologic evidence of specific nerve root or spinal cord compromise confirmed by appropriate imaging studies, can be expected to potentially benefit from surgery.
- Quality evidence exists from trials of lumbar spine patients, and is believed to apply to patients with cervical and thoracic spine pain, indicating that patient outcomes are not adversely affected by delaying surgery for weeks or a few months and continued conservative care is encouraged in patients with stable or improving neurologic deficits who desire to avoid surgery. However, patients with either moderate to severe neurological deficits that are not improving or trending to improvement at 4 to 6 weeks may benefit from earlier surgical intervention. Those with progressive neurological deficit(s) are believed to have indications for immediate surgery. Those with severe deficits that do not rapidly improve are also candidates for earlier testing and referrals. Those with myelopathy also are candidates for early surgical intervention.

- Nonphysical factors (such as psychiatric, psychosocial, environment including non-workplace and workplace issues, socioeconomic, litigation, or advocagenic problems) should be investigated and addressed in cases of delayed recovery or delayed return to work.
- Physicians can greatly improve patient clinical responses by providing assurance, encouraging activity, and emphasizing that more than 90% of cervical and thoracic spine pain resolves without any specific therapies. While patients may be looking for a clear-cut diagnosis for their axial spine pain, the risk from a suggested “cure” for this assumed diagnosis can result in failed expectations, which may be a worse outcome than their symptoms.
- Physicians should be aware that “abnormal” findings on x-rays, magnetic resonance images, and other diagnostic tests are so common by age 40, they are considered normal. There are higher rates of “abnormalities” in asymptomatic people in the cervical spine compared to the thoracic spine. Bulging disc prevalence continues to increase after age 40, and by age 60 will be encountered in 80% of patients’ cervical spines. This requires that a careful history and physical examination be conducted by a skilled physician in order to correlate historical, clinical, and imaging findings prior to assigning the finding on imaging to a patient’s complaints. It is recommended that physicians unable to make those correlations, and thus properly educate patients about these complex issues, should defer ordering imaging studies to a qualified consultant in musculoskeletal disorders (MSDs). Without proper education on prevalence, treatment, and prognosis, patients may become fixated on “fixing” their “abnormality” found on imaging (which may in fact be a completely normal condition) and thus iatrogenically increase their risk of developing chronic pain.

## Basic Principles and Definitions

**Active Therapy:** The term “active therapy” is generally thought of as the patient taking an active role in the treatment of their spine pain via various modalities. Although there is not one specific treatment defined by this term, it may include psychological, social, and educational components in conjunction with therapeutic exercises.<sup>(22)</sup> Therapeutic exercises could include light aerobic activity, directional exercises, muscle reconditioning (light-weight lifting or resistance training), physiotherapy,<sup>iii</sup> and active physical or occupational therapy.<sup>(23)</sup>

**Acute, Subacute, and Chronic Neck and Thoracic Spine Pain:** Acute, subacute, and chronic neck and thoracic spine pain are categorized as less than 1 month, 1 to 3 months, and greater than 3 months duration, respectively.

**Adjacent Segment Disease:** This theory postulates that if there is disease in one spinal segment, it increases the probability of disease in the neighboring segment. It is most commonly used to indicate the probability of a disc problem in the segment adjacent to a fused or otherwise operated upon segment. Whether this represents acceleration of degeneration by increased mechanical forces from the “stiffened” adjacent segment, and/or that degenerative change is genetically more frequent and/or more anatomically severe in those who have required surgery is controversial.<sup>(24, 25)</sup>

**Aggressive Exercise Therapy:** This therapy typically consists of cardiovascular training, strengthening of muscles, and stretching in order to improve spine function.<sup>(26, 27)</sup> Aggressive exercise therapy is a primary treatment for chronic cervical and thoracic pain and after various spine surgeries, and is frequently initiated in the course of treating subacute cervical and thoracic pain.

**Ankylosing Spondylitis:** Spondylitis is a chronic inflammation of the spine and the sacroiliac (SI) joints that tend to affect the lumbosacral spine modestly more than the cervical-thoracic spine.

**Bulging Intervertebral Disc:** The intervertebral disc is a fibrocartilaginous material. Its primary function is to allow slight movement between each individual spinal segment and significant ranges of motion when all segments are considered together as one functional unit. A disc also acts as a shock absorber for the spine and is composed of an annulus fibrosus (a broad circumferential ligamentous structure) surrounding the nucleus pulposus (a gel-like substance). Identification of a bulging intervertebral disc involves an assessment that the degree of natural disc bulging is larger than is typical at a given level. Bulging is defined as the symmetrical presence (or apparent presence) of disc tissue “circumferentially” (50 to 100%) beyond the edges of the ring apophyses and may be described as a “bulging disc” or “bulging appearance.” It is not considered a form of herniation. Furthermore, “bulging” is a descriptive term for the shape of the disc contour and not a diagnostic category. **Protrusion** is present if the greatest distance, in any plane, between the edges of the disc material beyond the disc space is less than the distance between the edges of the base, in the same plane. The base is defined as the

<sup>iii</sup>A large percentage of quality trials, probably a majority, use the term “physiotherapy,” which is particularly used in Europe.



cross-sectional area of disc material at the outer margin of the disc space of origin, where disc material displaced beyond the disc space is continuous with disc material within the disc space. In the cranio-caudal direction, the length of the base cannot exceed, by definition, the height of the intervertebral space. **Extrusion** is present when, in at least one plane, any one distance between the edges of the disc material beyond the disc space is greater than the distance between the edges of the base, or when no continuity exists between the disc material beyond the disc space and that within the disc space. Extrusion may be further specified as **sequestration** if the displaced disc material has lost completely any continuity with the parent disc.(28) Providers should be aware that disc bulging increases as a day progresses and is also magnified if an MRI is performed in a standing position.(29, 30) Other than relatively unusual situations (e.g., large lateral bulging into a narrowed neuroforaminal space or large central bulging into a narrowed spinal canal), bulging is thought to be an asymptomatic aging change in nearly all patients.

**Centralization:** a pattern of pain response elicited and reported by patients during a form of cervical assessment using various postures, often including end-range positioning, and repeated movements in one direction of testing at a time. When pain referred or radiating away from the spine retreats back toward or to the midline in response to a single direction of sustained or repeated positional spinal testing, that pain is “centralizing” or has “centralized.”(31)

**Chemonucleolysis:** Chemonucleolysis is the process of injecting chymopapain (or other enzyme) into the intervertebral disc to dissolve the gelatinous material within the disc. The disc then shrinks in size. This procedure is less invasive than spine surgery, but though shown to be successful is currently largely unavailable in the U.S.

**Chronic Nonspecific Cervical and Thoracic Spine Pain:** Cervical and/or thoracic spine pain lasting longer than 3 months (12 weeks) is defined in this document as “chronic.” Classification of the types of spine pain patients studied (e.g., chronic vs. subacute) in interventional studies evaluated in this document use this definition regardless of whether other definitions were used at the onset of chronic spine pain (e.g., some use a 6-month duration). Chronic spine pain is labeled as “nonspecific” when it is deemed to be not attributable to a recognized, known specific pathology.(32) The vast majority of chronic spine pain is in the category of non-specific spine pain. There is no scientific consensus that the pain-generating structure can be reliably identified in these pain syndromes. Included in this category are terms used to attempt to describe these patients with specificity that includes “specific” terms such as degenerative disc disease, discogenic spine pain, black disc disease, micro instability, cervical or thoracic spondylosis, facet syndrome, and myofascial pain. There are specific treatments that are used to target these patients and most of these are not supported by evidence from quality randomized controlled trials (RCTs). As the placebo or control populations used in many studies included throughout this document routinely improve, health care providers should not infer that improvement in pain with such treatment is quality evidence in support of a mechanistic theory.

**Delayed Recovery:** Delayed recovery is an increase in the period of time prior to returning to work or usual activities compared with the length of time expected based on average expectations, severity of the disorder, and treatments provided.

**Derangement:** A non-specific term purportedly a painful displacement within the spine often used by those performing manipulation. A derangement is considered by some proponents to be “reducible” when a directional preference and pain centralization are elicited during a mechanical evaluation using repeated end-range test movements.

**Directional Preference:** The single direction of end-range spinal bending or positioning tests that causes an individual’s pain to centralize, abolish, or both. Midline-only pain cannot centralize (it is already central) but often has a directional preference where a single direction of end-range bending or positioning eliminates that midline pain.

**Facetectomy:** Facet joints of the vertebrae (also called the zygapophysial joints) are synovial fluid lubricated joints located on each side of the posterior (back) of the spine. The joint is formed where each side of the vertebrae overlap one another. A facetectomy is the removal of the bone that forms these joints. This procedure is generally performed only in conjunction with other procedures such as fusion.

**Failed Spine (or Back) Surgery Syndrome:** Failed spine surgery syndrome (FSSS) is a term that is ill defined and sometimes used to label a heterogeneous set of post-operative conditions that are considered suboptimal results. The common denominator is a spinal surgery resulting in chronic pain and persistent or recurrent disability. The ICD-9 code 722.83 (post-laminectomy syndrome) is frequently used for this condition in the lumbar spine, and 722.81 is used in the cervical spine. While this term indicates that spinal surgery failed to achieve its pre-operative goals, there are patients with chronic pain who after spinal surgery improve with either time or subsequent appropriate treatment. Since physicians try to offer hope to

patients, use of this term in discussions with patients or in documents is strongly discouraged (cervical pain, thoracic pain, spine pain, or chronic cervical pain are preferable diagnoses, even if the office visit is coded as 722.81). However, because it is used in the ICD system and scientific literature, it is discussed in this document.

**Foramenotomy:** The intervertebral foramina are the normal gap through the bone between the vertebrae through which a spinal nerve root exits. A foramenotomy is the removal of part of the bone around the intervertebral foramina to increase the size of this passage.

**Functional Capacity Evaluation:** A functional capacity evaluation (FCE) is a comprehensive battery of performance-based tests to determine an individual's ability to do work-like tasks and conduct activities of daily living.(33) An FCE may be done to identify an individual's willingness/ability to perform specific tasks associated with a job (job-specific FCE), or his or her willingness/ability to perform physical activities associated with any job (general FCE). The term "capacity" used in FCE may be misleading, as an FCE generally measures performance tolerance (current demonstrated ability) and effort, rather than capacity. FCEs may be utilized for "Medical-Legal" purposes to attempt to address residual physical tolerances and potential for rehabilitation in preparation for judicial determination of loss of earning capacity (see discussion in Chronic Pain guideline).

**Functional Improvement (especially Objective Evidence):** Evaluation of the patient prior to the initiation of treatment should include documentation regarding pain level, objective physical findings, and current functional abilities both at home and at work. This should include a clear statement regarding what objective or functional goals are to be achieved through use of the treatment. These measures should be tracked during treatment and evidence of progress towards meeting these functional goals should be sought. Examples of documentation supporting improved function would be increased physical capabilities (with focus on job specific activities), and by the use of a validated tool(s), including the Neck Disability Index,(34-41) Bournemouth Neck Disability Questionnaire,(42) Modified Oswestry Questionnaire,(43, 44) Patient Specific Functional Scale, and Roland-Morris Disability Questionnaire.(45, 46) Resolution of physical findings (such as increased muscle tone, radicular symptoms, or weakness), increased range of motion, strength, or aerobic capacity may be physical examination correlates of improved function.

**Functional Restoration:** Functional restoration, like active therapy, is not one specific set of exercises, processes or therapies, but a blend of various techniques and programs (both physical and psychosocial). The basic principle for all of these individually tailored programs is to help patients cope with pain and return to the functioning level required for their daily needs and work activities.(47) Functional restoration refers to a full-day multidisciplinary program lasting from 3 to 6 weeks.(48) There also are work conditioning and work hardening programs that are utilized(49, 50) (see Chronic Pain guideline for further discussion).

**Herniated Intervertebral Disc:** A herniated intervertebral disc involves a defect in the annulus fibrosus with rupture of the nucleus pulposus through that opening. This is also sometimes referred to as an "extrusion," particularly in the radiological literature. This herniated disc may cause mechanical pressure on and/or is theorized to chemically irritate a nerve root, causing radicular (nerve root related) pain. The distinction between "bulging," protrusion, and extrusion is detailed in the above definition of a "bulging" disc.

**Laminectomy:** The lamina is the thin bony area of the vertebrae that covers the posterolateral aspect of the spinal canal. A laminectomy is the complete removal of one lamina to expose or access the spinal canal.

**Laminotomy:** A laminotomy is the partial removal of the lamina to expose or access the spinal canal.

**Myofascial Pain:** Proponents believe that pain arising from muscles and fascia can be recognized as distinct from pain arising from ligaments, joints, and discs. However, there is no valid way to determine whether the source of neck or thoracic pain is or is not from muscles or fascial structures. Even though some authors have published on "myofascial neck pain", in this review myofascial pain is considered as non-specific cervical or thoracic pain (see Shoulder Disorders guideline for myofascial pain and trigger points).

**McGill Pain Questionnaire:** The McGill Pain Questionnaire (MPQ) is a non-standardized instrument that attempts to quantify pain, describing pain not solely in terms of intensity, but also in terms of sensory, affective, and evaluative qualities. It was intended to provide a way of identifying differences among different methods of relieving pain.(51, 52) However, it has been noted that the MPQ may only address affective pain.(53)

**Myelopathy:** Impairment in the function of the spinal cord from external compression resulting in motor or sensory impairment in the limbs, and/or bowel and bladder control impairment. It is often associated with pathological changes in the spinal cord on MRI imaging. This is considered a serious neurological event or sequelae.

**Neck Disability Index:** The Neck Disability Index is a revised form of the Oswestry Low Back Pain Index for the assessment of activities of daily living of cervical pain patients, particularly from whiplash type injuries.(34-39, 41) It contains 10 sections addressing the impact of the cervical pain including – pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation.(34) However, the tool is not standardized and is frequently modified, making interpretations difficult.(54)

**Passive Modality:** Passive modalities refer to various types of treatment given by a provider that usually involve administration of some form of stimulus being applied to the body as opposed to the individual actively doing some sort of therapy (see Active Therapy, above). Forms of passive modality include massage, hydrotherapy (whirlpools, hot tubs, spas, etc.), ultrasound, and hot/cold compresses.

**Percutaneous Discectomy:** Percutaneous means “through the skin.” In the case of surgery, it typically means a small incision. Discectomy is the surgical removal of an intervertebral disc. Thus, a percutaneous discectomy is the removal of a portion of a spinal disc via a small incision (or puncture wound) through the skin.

**Physical or Occupational Therapy:** The term “physical therapy” is used in ACOEM’s *Guidelines* generically to mean physical medicine, therapeutic and rehabilitative evaluations and procedures. Much of the available research uses this term generically. This rehabilitative therapy may be performed by or under the direction of trained and licensed individuals such as physical therapists, occupational therapists, exercise physiologists, chiropractors, athletic trainers, and physicians. Jurisdictions may differ on the qualifications for licensure to perform these interventions. The *Guidelines* are not meant to restrict physical therapy to being performed only by physical therapists.

**Radicular Pain Syndrome:** Radicular pain syndrome refers to pain in the extremities (arms, hands, legs, and feet) that is caused by an associated nerve root being affected in or near the spine. Pain is usually substantially worse in the extremity than in the spine. Frequently, there are minor spine symptoms. An example is cervical radiculopathy from a disc herniation, most typically resulting in characteristic symptoms of pain radiating down the upper extremity in those specific nerve root distributions). Radiculopathy may result in numbness or paresthesias in the corresponding dermatome, muscle weakness in the corresponding myotome, and/or loss of muscle stretch reflex corresponding to the affected root level (see Table 4. Physical Examination Correlates of Cervical Nerve Root Dysfunction). The condition may occur with a thoracic nerve root, but is relatively uncommon.

**Slump Stretching:** The nerve is stretched by rounding the neck and back and flexing the hip to 90° with knee extension (ankle neutral or slightly dorsiflexed).

**Spinal Motion Segment:** The spine is made up of the vertebrae (bone) and connective tissue (specifically, the intervertebral discs and ligaments). A spinal motion segment, or functional unit of the spine, is considered to be two adjacent vertebrae, the intervening vertebral disc, the two facet joints and the connecting ligaments. If two vertebrae are completely fused together (surgically or otherwise), then the spinal motion of that segment becomes zero, and the overall range of motion for the entire spine is decreased.

**Spinal Stenosis:** Spinal stenosis is narrowing of the spinal canal with neurological impingement on the spinal cord and nerves. Symptoms include neck and extremity pain. Spinal stenosis may be associated with myelopathic findings if there is significant compression of the spinal cord (see **Myelopathy**). This condition is most often degenerative, though it may be acquired after significant trauma resulting in spondylolisthesis. Most commonly, spinal stenosis involves a combination of factors that may include facet joint osteoarthritis with osteophytes, intervertebral disc space narrowing, hypertrophy of the ligamentum flavum and other ligamentous structures, and/or congenital narrowing of the spinal canal.

**Spondylolisthesis:** Spondylolisthesis is usually classified as isthmic and/or degenerative. Spondylolisthesis is the abnormal alignment of one vertebra in relation to the adjacent vertebral body usually measured in millimeters of displacement between the posterior aspects of the two vertebral bodies. Isthmic spondylolisthesis is a congenital defect. Fractures may also occur in childhood (e.g., non-union of a stress fracture) and produce or contribute to spondylolisthesis, but requires high forces, generally repeated, such as football linemen and female gymnasts. This form of spondylolisthesis rarely progresses once skeletal maturity is attained. It frequently is asymptomatic, but may be rendered symptomatic by adult trauma. Degenerative spondylolisthesis has a different pathophysiology. It occurs as the facet joints and adjacent disc lose their

stabilizing ability due to degenerative changes (e.g., facet joint osteoarthritis and degenerative disc space narrowing), typically in those over age 60. The degree of spondylolisthesis tends to increase with age-related changes, especially as the degree of disc space narrowing advances. It is usually thought to be asymptomatic unless there is neurological impingement (e.g., accompanying spinal stenosis), or the severity is sufficiently great that there is instability. While most commonly degenerative, it may also be acquired from major trauma.

**Spondylosis:** Spondylosis is the age-related degeneration of the vertebral disc in each segment of the spine or the natural aging degeneration. It is sometimes used synonymously with the term “degenerative disc disease.” This process may involve the spinal facets as well as the disc. Cervical spondylosis may also lead to spinal stenosis (a narrowing of the spinal canal) putting pressure on the spinal cord and other nerves.(55) Spondylosis is generally considered to be a normal process of aging and is generally thought to be asymptomatic unless neurological impingement results. This condition is generally insignificant unless the individual has a congenitally narrowed spinal canal (i.e., congenital cervical canal stenosis).

**Visual Analog Scale:** Visual Analog Scales (VAS) are figures of lines that are used to measure a patient’s level of subjective pain. There are different types of VAS pain scales, but nearly all range in value from “0” or “no pain” to “10” or “worst pain” (or 0 to 100). Some have no numeric designation on them; instead a line is drawn between the extreme ends of the line noted as “no pain” and “severe pain” and the patient’s “x” on the line is used to measure the fraction or distance between the ends. Some are 0 to 100mm in length. Some have additional verbal anchors such as “mild” and “moderate.” Despite these nuances, the performance of these various VAS scales is believed to be valid and reliable.

## Initial Assessment

Thorough medical and work histories and a focused physical examination (see General Approach to Initial Assessment and Documentation guideline) are sufficient for the initial assessment of a patient complaining of potentially work-related neck or thoracic spine symptoms. Findings of the medical history and physical examination may alert the physician to other pathology (e.g., not of spine origin) that can present as spine disorders. In this assessment, certain findings, referred to as red flags, raise suspicion of serious underlying medical conditions (see Table 1. Red Flags for Potentially Serious Neck or Thoracic Spine Conditions). The absence of red flags and conditions rules out the need for special studies, referral, or inpatient care during the first 4 to 6 weeks. During this time, spontaneous recovery is expected, provided any associated workplace factors are mitigated.(32)

There also are potential psychological conditions that may be confounding and/or interacting and should be evaluated, such as PTSD, suicidality, childhood sexual abuse, hallucinations or intoxication, which have been called primary risk factors,(56) and have been reviewed elsewhere.(57) Suicidality though is a potentially fatal complication, which makes it a more severe complication than cauda equina.

## Red Flags

Features of the patient’s history or examination that indicate the possibility of potentially serious disorders are referred to as “red flags.” These include features that suggest the possibility of acute fractures, acute dislocations (e.g., spondylolisthesis), spinal infection, tumor, or serious or progressive neurologic deficit. While recognizing these “red flag” disorders is clearly important, there are no high quality prospective cohort studies to provide the evidence base for this section of the guidelines.

**Table 1. Red Flags for Potentially Serious Neck or Thoracic Spine Conditions**

Disorder	Medical History	Physical Examination/Diagnostic Testing
<b>SPINAL DISORDERS</b>		
<b>Fracture</b>	<p>Major trauma, such as vehicular accident or fall from height(58) (Boissonnault 05)</p> <p>Minor trauma or strenuous lifting in older or potentially osteoporotic patients</p> <p>Metabolic risks for osteopenia (including renal failure, hyperthyroidism, rheumatic disorders, debility and inheritance)</p>	<p>Percussion tenderness over specific spinous processes</p> <p>Careful neurological examination for signs of neurological compromise</p>

Disorder	Medical History	Physical Examination/Diagnostic Testing
<b>Tumor and Neoplasia</b>	Severe localized pain over specific spinal processes History of cancer Age >50 years Constitutional symptoms, such as recent unexplained weight loss or fatigue Pain that worsens when patient is supine Pain at night or at rest	Pallor, reduced blood pressure, diffuse weakness Tenderness over spinous process and percussion tenderness Decreased range of motion due to protective muscle spasm C8 or T1 nerve root (or ulnar nerve) symptoms or findings, especially in a smoker (Pancoast tumor) Other neurological impairment
<b>Infection</b>	Risk factors for spinal infection: recent bacterial infection (e.g., urinary tract infection); I.V. drug abuse; diabetes mellitus; or immune suppression (due to corticosteroids, transplant, or HIV) Constitutional symptoms, such as recent fever, chills, or unexplained weight loss	Tenderness over spinous processes Decreased range of motion Vital signs consistent with systemic infection (late): <ul style="list-style-type: none"> <li>▪ Tachycardia</li> <li>▪ Tachypnea</li> <li>▪ Hypotension</li> <li>▪ Elevated temperature, high white blood cell count, or inflammatory markers (sedimentation rate, C-reactive protein, etc.)</li> <li>▪ Pelvic or abdominal mass or tenderness</li> </ul> Neurological impairment(s)
<b>Progressive Neurologic Deficit</b>	Severe spine pain Progressive limb numbness or weakness, bowel or bladder control impairment, gait ataxia	Significant and progressive myotomal motor weakness Significant and increased sensory loss – in anatomical distribution Radicular signs Corticospinal tract involvement (gait ataxia, Babinski sign, hyperreflexia, and limb spasticity, etc.) Other neurological impairment(s)
<b>Myelopathy</b>	Ataxic gait, impaired upper limb coordination, poor or reduced finger movements, bladder and/or bowel control impairment (incontinence)	Hyperreflexia, ataxia, clonus, pathologic reflexes (Babinski, Hoffman) Other neurological impairment(s)
<b>EXTRASPINAL DISORDERS</b>		
<b>Pneumonia</b>	Fatigue Dyspnea May have chest pain, usually pleuritic Sputum production Subacute onset without inciting event	Fever, tachypnea Decreased breath sounds. May have rhonchous breath sounds, generally in only 1 or 2 segments, but could be widespread Dullness to chest percussion Purulent sputum

Adapted from van den Hoogen 95; Jarvik 02; Bigos 94.(59-61)

## Absence of Red Flags

Absent red flags, cervical and thoracic disorders can usually be classified into one of two working categories:

- **Nonspecific disorders**, including benign, self-limited disorders with unclear etiology, such as regional cervical pain. This includes the overwhelming majority of cervical pain patients' problems, generally over 95% of those with acute cervical pain.

- **Specific disorders**, including potentially degenerative disorders such as herniated discs, spinal stenosis, and other neurological impingements.

It should be noted that there may be overlap between these two categories.

## Cervical Pain

More than 90% of patients have no identifiable cause for their cervical pain.(62) Symptoms are pain, usually without radiation to the limb, although some patients have radiation into the interscapular area or upper trapezii. Radiation into an arm or forearm generally signifies radiculopathy, particularly when the radicular pain in the extremity exceeds that in the neck or is the sole complaint. Patients with cervical pain generally have no limb tingling, numbness, or muscle weakness other than weakness associated with pain-producing activities. Some physicians refer to these patients as having incurred “sprains” and/or “strains”; however, these labels are not appropriate. A sprain is a disrupted ligament and a strain is a myotendinous junction disruption. Both imply knowledge of the anatomic cause of cervical pain and a forceful mechanism of injury when the former is untrue for cervical pain patients and the latter may or may not be true. Most cervical “sprains” or “strains” occur doing tasks the individual has done before without difficulty and which do not put a significant biomechanical load on the spine. The event the patient associates with the pain onset usually reflects when the pain first occurred rather than why the pain occurred. Use of those terms also confuses the proper use of those diagnoses elsewhere in the body and becomes problematic in determination of work-relatedness. Therefore, the term “nonspecific” cervical pain should be used to describe these symptoms.(63)

## Thoracic Pain

The same pathophysiological mechanisms, conditions, and treatments apply to the thoracic spine as they do for the cervical and lumbar spine with modest differences. Degenerative anatomic changes are very common, if not universal, with age. However, the thoracic spine is considerably less mobile and, as a consequence is believed to result in a lower prevalence of pain syndromes commonly attributed to degenerative changes, and when these syndromes do occur, they are usually milder conditions. Yet, these conditions are common in the thoracic spine with MRI evidence of herniations (37%), bulging discs (53%), annular tears (58%), deformation of spinal cords by discs (29%), Scheurmann end-plate irregularities or kyphosis (38%) and degenerative findings (56%).(64) There are no quality studies identified for treatment of thoracic spine conditions, and all recommendations are based on consensus analogy to the treatment of the cervical and lumbar spine, but have insufficient evidence.

## Radicular Pain Syndromes

Radicular pain denotes pain that is in a specific neurological distribution, nearly always involving only one nerve root. Symptoms are pain, tingling and numbness, and muscle weakness. Corresponding signs, including sensory loss, muscle weakness, and a diminished reflex(es) all in the distribution of that one nerve root, may be present. The diagnosis of radiculopathy is generally not complex in more severely affected individuals. It becomes more difficult with milder symptoms, as historical features and physical examination findings may be less pronounced or many physical examination findings may be largely absent. There is a clinical prediction rule in the diagnosis of cervical radiculopathy. It includes Spurling test, distraction test, upper limb tension test (ULLT1), and ipsilateral cervical rotation of less than 60 degrees.(41) It has been reported that when 3 of the 4 signs are present on exam the specificity is 94%, sensitivity is 24%, and positive likelihood ratio is 6.1. When all 4 physical exam signs are present the specificity is 99%, sensitivity is 39% and positive likelihood ratio is 30.3.(41) These were originally reported in Wainner et al 2003, and have not been validated.(65)

There are multiple possible causes of radicular pain. Most commonly, in the cervical spine in younger individuals this is due to a herniated intervertebral disc. Such a herniation involves a rupture in the annulus fibrosus and extrusion of nucleus pulposus material, also referred to as an extrusion. A combination of a physical displacement of the material along with a purported inflammatory chemical reaction to this material is believed to be responsible for the development of the symptoms of neurological compromise. It is also possible for a severe degenerative arthritic process to result in substantial osteophytic growth around the facet joint and/or intervertebral disc space and cause radicular symptoms. In elderly individuals this cervical spondylosis is the most common cause of radicular neck syndromes.

**Uncovertebral joints (also called Joints of Luschka)** are formed between uncinat processes above, and uncus below. These are “joints” without joint capsules or synovial fluid. They are located in the cervical region of the spine between C3 and C6.

Two lips project upward from the superior surface of the vertebral body below, and one projects downward from the inferior surface of vertebral body above. They allow for flexion and extension and limit lateral flexion in the cervical spine. They can enlarge and be part of the spinal stenosis process at these levels in the cervical spine. There is considerable controversy regarding whether these are pain-generating structures and some therapeutic interventions specifically target these joints.

## Zygapophysial (Facet) Joint Degenerative Joint Disease

Facet joints are synovial fluid filled, synovium lined, ligamentously encapsulated joints that are in alignment along the posterior aspect of the spinal column. They are in many ways similar to nearly all other joints in the body (the main exceptions are the intervertebral discs). Not surprisingly, facet joints are prone towards the same maladies that affect other joints, including osteoarthritis (degenerative joint disease), gout,<sup>(66)</sup> psoriatic arthritis, and many other arthritides. There appears to be a propensity towards facet joint osteoarthritis in those with osteoarthritis elsewhere in the body, sometimes referred to as “systemic osteoarthritis.”

The diagnosis of radiographic facet joint osteoarthritis is relatively straightforward. Roentgenograms, particularly facet joint (or rotated) views for the lumbar spine and lateral views for the cervical spine, will show evidence of degenerative findings (i.e., sclerosis, joint space narrowing, and cyst formation). However, the diagnosis of pain arising from such degenerative joints is not straightforward. Osteoarthritis in the spine is extremely common (so common that many physicians do not record these abnormal findings, especially when mild or moderate on imaging, as they are “normal” for age). It appears to be largely asymptomatic. In those with multiple levels affected, there often is not pain at all of those levels. As cervical pain is so common and the overwhelming anatomic cause of cervical pain is unknown, it follows that attempting to diagnose the pain as related to a specific structure such as the facet joints is quite challenging.<sup>(67)</sup>

Important diagnostic limitations to the use of diagnostic facet blocks are that they are often accomplished involving intra-articular injection(s) of anesthetic agents. Results of the procedure therefore cannot be directly related to the value of neurotomies.<sup>(68)</sup> Other limitations to the use of diagnostic blocks include single level diagnostic blocks vs. multiple level blocks and the use of corticosteroids. Problems with diagnostic blocks of the dorsal root rami include: 1) the ability to anesthetize the joint; 2) the specificity to not anesthetize adjacent neural structures; and 3) the likelihood ratio of a single diagnostic block.<sup>(67-69)</sup>

## Clinical Syndromes

The inability of conventional clinical testing and advanced imaging to reliably identify an anatomic pain source for most cervical and lumbar pain has stimulated research attempting to reliably identify and validate clinical syndromes or subgroups based on clusters of clinical examination findings. If homogeneous syndromes are validated, this should enable more effective individualized care than a less specific approach towards all non-specific cervical pain.

One syndrome with perhaps more support than others, especially in the lumbar spine, is “directional preference.” A directional preference is often identifiable in a patient’s history and examination. Directional preference patients typically describe a history of episodic and intermittent LBP with a directional theme as to what positions, movements and activities commence or worsen their pain (e.g., flexion) and what improves or stops their pain. A presumptive pain generator’s directional preference is that single direction of repeated end-range spinal bending tests or static positioning that causes the pain to “centralize,” abolish, or both. Pain “centralization” is a pattern of pain response whereby pain referred or radiating away from the spine retreats back toward or to the midline in response to a single direction of sustained or repeated end-range spinal testing. Midline-only pain cannot centralize because it is already central but it also frequently appears to have a directional preference where a single direction of testing will reduce or eliminate the patient’s midline pain. After pain centralization or elimination, the pain typically remains improved until or unless the patient moves excessively in the opposite direction of the preferred direction. According to this syndrome’s constructs, avoiding moving in a direction that aggravates the pain should be taught, minimized, and avoided especially during the early phase of treatment to speed recovery.

The unique theoretical purpose of these end-range tests, performed in weight-bearing and recumbency, is to load the spine in different bending directions. The most common cervical directional preference is lower cervical extension, yet smaller numbers of pain-generators benefit from other directions of loading: lateral, rotational or flexion movements. Those with an

extension directional preference typically worsen with lumbar flexion and improve with extension or simply restoring their lordosis.

This syndrome has been referred to as a “reducible derangement” or a “directional preference syndrome.” Its two characteristic clinical findings (directional preference and pain centralization) purportedly have strong interexaminer reliability (Kappa = 0.9, 0.823, 0.7, % agreement: 88-100%), with training.(70-73)

The prevalence of this directional preference syndrome is reportedly high in the lumbar and cervical spine: 70-89% of acute(74, 75, 76, 77) and 40-50% in chronic pain.(78-81) It is commonly elicited in axial, referred, as well as radicular pain.(82-84) There is also suggestive evidence of a concomitant psychosocial benefit by teaching and empowerment with the knowledge and skills to effectively self-treat.(85)

## Medical History and Physical Examination

A focused and detailed medical history and physical examination are necessary to assess the patient’s medical condition and specific cervical or thoracic complaint. This section reviews the medical history including the questions that should be asked by the examiner.

The context of the appearance of the patient in the clinic is important. Patients with spine disorders generally initiate treatment due to pain, which is often attributed to an ostensible injury. However, acute spinal pain is not usually directly attributable to a discrete, definable pathophysiology Pain is also commonly associated with sensory, affective, cognitive, social and other processes.(86-88) The pain sensory system itself is organized into two parts, often called first and second pain. A-δ nerve fibers conduct first pain via the neospinothalamic tract to the somatosensory cortex, and provide information about pain location and quality. In contrast, unmyelinated C fibers conduct second pain via the paleospinothalamic tract, and provide information about pain intensity. Second pain is more closely associated with emotion and memory neural systems than it is with sensory systems.(89-91)

As a patient’s condition transitions through the acute, subacute and chronic phases, the central nervous system is believed to undergo reorganization. The temporal summation of second pain produces a sensitization or “windup” of the spinal cord,(92) and the connections between the brain regions involved in pain perception, emotion, arousal, and judgment are changed by persistent pain.(93) According to this theory, these changes cause the CNS’s “pain neuromatrix” to become sensitized to pain.(86-88) This CNS reorganization is also associated with changes in the volume of brain areas,(94) decreased gray matter in the prefrontal cortex,(94) and the brain appearing to age more rapidly.(95) As pain continues over time, the CNS remodels itself so that pain becomes less closely associated with sensation, and more closely associated with arousal, emotion, memory and beliefs.(90, 96) Because of these CNS processes, one should be aware that as the patient enters the subacute phase, it becomes increasingly important to consider the psychosocial context of the disorder being treated, including the patient’s social circumstances, arousal level, emotional state, and beliefs about the disorder. However, behavioral complications and physiological changes associated with chronicity and central sensitization may also be present in the acute phase, and within hours of the initial injury.(97)

## Medical History

No scientific studies of the medical history in patients with cervical pain(98, 99) or thoracic pain are available. Asking the patient open-ended questions, such as those listed below in items 2 through 8, allows the physician to gauge the need for further discussion or specific inquiries to obtain more detailed information.

1. What are your symptoms?
  - Do you have pain or stiffness?
  - Do you have numbness or tingling?
  - For traumatic injuries: Was the area deformed? Did you lose any blood or have an open wound?
  - Is the discomfort located primarily in your thoracic/mid-back? Neck? Arm?
  - Do you have pain or other symptoms elsewhere? (Patients who present with a primary complaint of upper extremity pain may well have radiculopathy from a cervical disc herniation or other cervical spine or cervicothoracic spine pathology.)
  - Do you have clumsiness with your hands or a change in your ability to walk?
  - Have you lost control of your bowel or bladder? Are you soiling your undergarments?
  - Do you have fever, night sweats, or weight loss?



- When did your symptoms begin? Are your symptoms constant or intermittent? What makes the problem worse or better?
  - What is the day pattern to your pain? Are you better first getting out of bed in the morning, during the morning, mid-day, evening, or while asleep? Are you worse as the day progresses? Do you have a problem sleeping? What position is most comfortable? Is there any pain with cough, sneezing, deep breathing, or laughing?
  - What positions, activities, or movements make your pain worse (more intense or radiate further into periphery)?
  - What positions, activities, or movements make your pain better (less intense or less peripheral radiation, i.e., centralization)?
  - How long can you sit, stand, walk, and bend your back or neck?
  - How much weight can you lift (use items such as a gallon of milk, bag of groceries, etc., as examples)?
2. How did your condition develop?
- Past:*
- Have you had similar episodes previously?
  - Have you had previous testing or treatment? With whom?
- Cause:*
- What were you doing when you first noticed the symptoms? (It is important to obtain all information necessary to document the biomechanical forces of injury.)
  - What do you think caused the problem?
  - How do you think it is related to work?
  - Did your symptoms begin gradually or suddenly? Did you notice the pain the day after the event?
- Job:*
- What are your specific job duties?
  - How long do you spend performing each duty on a daily basis?
  - Do you have assistance of other people or lifting devices?
- Non-occupational Activities:*
- What other activities (hobbies, workouts, sports) do you engage in? At home or elsewhere?
  - Any physically demanding activities requiring heavy lifting, awkward postures, prolonged sitting or standing?
3. How do these symptoms limit you?
- What activities of daily living are limited? Are there specific challenges in your home environment (e.g., steep steps)?
  - How long have your activities been limited?
  - Have your symptoms changed over time? How?
4. Do you have other medical problems?
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 neck or mid-back 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?

Indices of functional ability are often incorporated in the history. There are several validated and partially validated tools including the Neck Disability Index,(34-41) Bournemouth Neck Disability Questionnaire,(42) Modified Oswestry Questionnaire,(43, 44) Patient Specific Functional Scale, and Roland-Morris Disability Questionnaire.(45, 46)

## Physical Examination

The objective of the physical examination of the cervicothoracic spine is to document a patient's baseline status from which to judge future improvement and to detect nerve root or spinal cord impairment that might suggest the need for specific tests and treatment. The examination begins as soon as the physician introduces him or herself to the patient, particularly including observations of positioning; use or disuse of the neck, shoulders and arms; skin color and signs of distress. Vital signs, such as an elevated temperature, may suggest the presence of an infection or neoplasm. Tachycardia may be a

sympathetic nervous system response to the patient’s pain or it may be anxiety related. For those undergoing more advanced testing for chronic pain, tachycardia may also be relevant as indicating potential anxiety.

The three primary distributions for spine pain are those that are:

1. Localized to the paraspinal area of the neck, with or without radiation to the shoulder or scapular area.
2. Referred to the paraspinal area of the thoracic spine (that can be from a musculoskeletal source or from internal organs such as heart, lungs, or abdominal aneurysm).
3. In the cervical or upper thoracic spine and accompanied by pain or numbness referred to the extremities in a dermatomal or myotomal distribution and that may suggest nerve root involvement. In addition, there may be lower limb, and/or bowel or bladder control impairment symptoms that suggest spinal cord involvement (myelopathy). (100, 101)

Guided by the medical history, the physical examination includes:

- General observation of the patient, including changes in positions, stance, and gait;
- Regional examination of the cervical and thoracic spine;
- Examination of organ systems related to appropriate differential diagnosis possibilities;
- Neurologic examination;
- Testing for cervical nerve root tension;
- Monitoring pain behavior during range of motion and while seated as a clue to origin of the problem; and
- Head protrusion (lower cervical flexion) and retraction (lower cervical extension) positions and repeated movements to determine symptom response. (102)

The completely objective parts of the cervical and thoracic spine examination are limited to circumferential measurements for atrophy or findings of fasciculations (rarely present visible rhythmic contraction of small portions of a muscle). All other findings require the patient’s cooperation, although reflexes and pin-prick in a dermatomal distribution are generally much more objective than subjective.

Determining whether or not there is cervicothoracic nerve root compromise (and if so, the level of compromise) is important. Symptoms correlating with specific dermatomal and myotomal levels of compression and possible motor weakness are shown in Table 2.

**Table 2. Symptoms of Cervicothoracic Nerve Root Compromise**

Root Level	Pain or Paresthesia	Motor Weakness
C1		
C2	Occipital region	
C3	Ear	Neck rotation, shoulder elevation, diaphragm
C4	Top of Shoulders	Shoulder elevation
C5	Medial scapular border, lateral upper arm to elbow	Deltoid, supraspinatus, infraspinatus
C6	Lateral forearm, thumb and index finger	Biceps, brachioradialis, wrist extensors
C7	Medial scapula, posterior arm, dorsum of forearm, middle finger (3rd digit)	Triceps, wrist flexors, finger extensors, radial wrist extension
C8	Shoulder, ulnar side of forearm, little finger, (5th digit)	Thumb flexors, abductors, intrinsic hand muscles
T1	Upper medial forearm, medial arm	Finger abduction, adduction
T2-T12	Mid to low back pain, radiating around the torso towards the anterior midline	Generally none perceptible on examination unless multiple nerve roots involved

## A. Observation And Regional Neck Examination

This section on examination applies to patients presenting to an office-based examiner, and not to those presenting to an emergency room. Shoulder disorders commonly have symptoms that are similar to those of neck and mid back disorders, and distinguishing whether a patient has a neck/mid thoracic problem, a shoulder problem, or both can be challenging. Shoulder pain can occasionally or frequently radiate to at least the mid arm. The reader is referred to the guideline on shoulder disorders for a discussion of the history and physical examination of the shoulder, but patients presenting with complaints suggesting cervical and thoracic spine disorders should routinely have a physical examination of the shoulder.

An important part of the examination is the observation of the patient with cervical and thoracic spine pain. This includes head and upper thoracic posture, stance, and gait. The patient should be asked to walk down the hallway so there is sufficient distance over which to observe the gait and spine posture. In the process, the ease with which the patient stands up and moves the cervical and thoracic spine should be carefully observed. Most patients should be observed over at least 20 feet of ambulation. The examiner should observe whether the spine is maintained in a normal or a flexed posture, and whether there is normal spine motion during gait or “stiff necked” gait. Gait fluidity should be carefully observed. How the patient turns around to return to the examination room is also of interest. Acute cervical and thoracic spine pain usually decreases the mobility of the spine and produces restriction of normal spinal movement during gait.

The disrobed, but modestly covered, patient is examined standing. The neck and spine are viewed from behind, laterally, and anteriorly for alignment. The levels of the shoulders and any lateral spinal curves (scoliosis) if present should be noted. The patient should have the shoulders and knees level so any discrepancy will not be due to a weight shift. The spine is compensated if the first thoracic vertebra is centered over the sacrum. A tape measure end held over the T1 spinous process can be used as a plumb line to verify this. The upper extremities should be in normal alignment and used normally. Patients with acute cervical or thoracic muscle spasm may demonstrate a list to one side – a compensatory scoliosis, with loss of normal spinal contours. “Spasm” cannot be reliably detected by palpation, but may be seen if it produces a list (deviated posture) or scoliosis.

The patient should perform ranges of motion (ROM) of the neck in all cardinal directions (flexion, extension, axial rotation, and lateral bending).(102, 103) Normal ROM is 50° for forward flexion, 60° for extension, 45° for lateral bending, and 80° for rotation,(103, 104) although ROM may decline with age in certain disorders. Spinal motion is important in terms of symmetry and rhythm. The absolute ROM is not of major diagnostic significance because of wide variance. Asymmetries should be noted. Inquiries regarding which of these positions produced pain, if any, are also of interest and may be useful therapeutically. Initial ROM is thought to be predictive of future limitations and disability.(105) ROM is believed to become normal within 3 months of a whiplash injury.(106)

Qualitative muscle strength testing of the upper extremity muscles should be performed.(103) Both proximal and distal muscle strength should be assessed. When differences are mild, repeated testing may accentuate decrements through revealing earlier fatigue of affected muscle groups. Shoulder girdle strength testing may include resisted supraspinatus (thumb down shoulder abduction or the empty can test), biceps and triceps testing. Distal upper extremity muscle strength screening generally includes resisted wrist extension, flexion, phalangeal flexion, and intrinsic muscles.

The patient generates uniform resistance to pressure that is overcome in a smooth fashion. Patients may demonstrate give-way weakness, which is manifested by either resisted pressure for a few seconds and then sudden release of the muscle or demonstrate a stepwise release of the muscle resulting in a cogwheel or ratcheting effect. Causes of give-way weakness frequently include submaximal efforts, but can be due to other causes including pain, misunderstanding of directions, and attempting to help the examiner. The probability of feigning rises if the directions are repeated and give-way weakness remains. Testing extremity flexion bilaterally and simultaneously may help identify a mechanism for observed give-way weakness.(107-109)

In addition to the soft tissue, bony structures should be palpated. The spinous processes are covered by ligamentous structures, not muscle, and are easily palpated. Localized tenderness may suggest the presence of an isolated process, such as an infection, tumor, or fracture affecting that vertebral body. Tenderness over spinous processes is considered a sign of amplification in patients with non-specific spine pain, although it is also often present among those with fibromyalgia.(107)

Assessment of the neurologic status of the patient is important in the overall cervicothoracic evaluation. The history is the most critical feature and guides the degree to which the neurological testing must be performed. A positive neurologic finding will give objectivity to the patient’s subjective complaints. Each nerve root must be examined (Table 2). Abnormalities of motor, sensory, and reflex function are tested. It is worthwhile to review the anatomy of the nerve roots in order to better understand abnormalities discovered during the neurologic examination.

Each nerve root, as it leaves the spinal canal through the neural foramen, is enclosed within a sleeve that contains spinal fluid and small blood vessels about and within the nerve. This sac, referred to as the dural sleeve, provides nourishment to a particular nerve root. Compression and/or traction on the dura may compress the dural sleeve’s contents and encroach upon the nerve and its blood supply. It is thought that compression may cause pain along the course of the peripheral nerve, which and may be accompanied by dysesthesias, motor weakness, and decreased reflex function associated with the affected nerve root. The goal of many of the maneuvers done during this phase of the examination is to increase nerve compression to

uncover neurologic dysfunction. These maneuvers have been reported to have high positive predictive value and specificity.(41, 110)

Of the possible neurologic abnormalities, true muscle weakness is the most reliable indicator of persistent nerve injury with atrophy and loss of nerve conduction.(111-114) Sensory changes are subjective, take significant time to document, and require the full cooperation and attention of the patient. Reflex changes may have permanently occurred in a previous episode of nerve root compression. Reflexes may not return even with recovery of sensory and motor function. With age, but also with some medical conditions such as diabetes mellitus and hypothyroidism, reflexes diminish and are more difficult to elicit, even without any prior history of nerve compression. The normal loss of reflexes is generally symmetric.(115, 116) Patients who lose reflexes in both upper extremities on the basis of compression may have spinal stenosis or a large central disc herniation.

In addition to nerve root lesions, upper motor neuron and peripheral nerve disease cause abnormalities that may be discovered during the neurologic exam. With upper motor neuron lesions, the fine control of muscles is lost while the trophic effects of the peripheral nerves remain intact (no atrophy or needle EMG changes occur). Muscle strength is diminished, but in a different pattern from lower motor neuron weakness. Patients develop spasticity of muscles (tonic contractions) and hyper-reflexia. Patients may also develop a positive Hoffmann’s reflex (aka finger flexor reflex: flexion of the thumb tip due to tapping the nail or flicking the tip of the third or fourth finger) or Babinski reflex (extension of the large toe and spreading of other toes with stroking of the sole of the foot). Ankle clonus, an involuntary rhythmic plantar flexion motion after rapid dorsiflexion of the ankle may also suggest upper motor neuron compression. Peripheral nerve injuries may cause sensory and/or motor abnormalities, but in the distribution of the peripheral nerve, and not in the pattern of a specific spinal nerve root. Peripheral nerves receive nerve fibers from a number of nerve root levels.

Perhaps the most widely used physical examination sign for cervical radiculopathy is the Spurling’s test,(117, 118) which when positive results in a reproduction of distal upper extremity symptoms consistent with the patients symptoms and generally isolated to the distribution of one nerve root. This maneuver, as originally described, involves the patient partially extending the neck and rotating the chin toward the affected extremity while the examiner applies an axial load to the spine to provide further compression of the neuroforamen on that side.(119) Mere production of cervical pain with this maneuver does not signify neurological compromise and appears frequently misrecorded as it must involve pain in that nerve root’s distribution.

**Table 3. The reliability of neck physical examination tests has been reported below. These data suggest a wide range in reproducibility.**

Test	Inter-rater reliability: Kappa*
Range of motion	0.05 – 0.61
Neck and Upper Limb Strength Testing	≤ 0.60
Trigger Point Palpation	0.24 – 0.56
Sensory Exam: Light touch and pin prick	0.16 – 0.67
“Non-Organic” Signs	0.08 – 1.00
Composite exam: inspection, range of motion, palpation, and provocative tests	-0.18 – 0.52

\*Kappa values that are higher are more reproducible.

Adapted from Nordin M, Carragee E, Hogg-Johnson S, et al. Assessment of neck pain and associated disorders: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine*. 2008;33(4S):S101-22.

## B. Neurologic Screening

The most important neurologic deficit to recognize is myelopathy from spinal cord compression. Patients may have symptoms of cervical pain, and arm numbness and/or weakness like other patients with neck disorders. However, many also have additional symptoms of gait abnormality, leg numbness and/or weakness, and some have bowel or bladder control impairment.(120)

Physical examination findings that correlate with significant myelopathy are:

1. Hyperreflexia (Grade 3 or greater);
2. Hoffman reflex (observing reflex flexion of the thumb distal phalanx when the distal phalanx of the middle finger is “flicked” or suddenly passively pushed into flexion at the DIP joint);

3. Inverted brachioradialis reflex (during testing the brachioradialis reflex there is a decreased response from the brachioradialis and an abnormal flexion response of the fingers);
4. Ankle clonus (forcefully dorsiflexing the ankle and maintaining pressure on the sole of the foot to maintain ankle dorsiflexion and observing for rhythmic beats of ankle flexion and extension, at least 4 “beats” required for sustained clonus to be abnormal);
5. Babinski sign or reflex – firmly sweeping the pointed end of a reflex hammer from the lateral sole to the base of the toes and observing for an extensor response of the hallux (great toe);
6. Cervical stenosis – while not a physical examination finding per se, it should be recognized that myelopathy is strongly linked to cervical stenosis, particularly congenital.

The neurologic examination most commonly focuses on a few tests that reveal evidence of nerve root impairment, peripheral neuropathy, or spinal cord dysfunction. The most common herniated disc in the cervical spine is the C5-C6 disc with impingement of the C6 nerve root. The clinical features of cervical nerve root compression are summarized in Table 4.

### 1. Testing for Muscle Strength

There are no specific muscle tests for the C1 to C2 nerve roots.

**Table 4. Physical Examination Correlates of Cervical Nerve Root Dysfunction**

Root Level	Sensory Deficit	Motor Weakness	Reflex
C3	Ear, anterior neck, occiput, posterior temporal area	Not usually detectable	None
C4	Shoulder, posterior upper arm, upper chest	Not usually detectable	None
C5	Lateral shoulder, upper arm	Shoulder abduction, elbow flexion	Biceps
C6	Lateral forearm, <b>thumb</b> ,* and perhaps index finger	wrist extension (ECRL/ECRB) and elbow flexion (biceps)	Brachioradialis, and possibly biceps
C7	<b>Middle</b> finger*	Elbow extension (triceps), wrist flexion, finger extension	Triceps
C8	Distal forearm, ulnar ring, and <b>little</b> * finger	Finger flexion	Triceps
T1	Medial upper forearm and arm	middle finger flexion, finger abduction and adduction	None
T2-T12	Unilateral, dermatomal based on nerve root(s) affected	Generally none unless multiple roots affected	None

\*These are the most common sensory nerve deficits related to cervical nerve root dysfunction.

### 2. Circumferential Measurements

Muscle atrophy is one of the few purely objective findings and can be measured with bilateral circumferential measurements of the upper arms and forearms at a fixed distance from an anatomic point (e.g., olecranon process). However, the dominant upper extremity usually may have an increase of up to 1cm. in circumference at the forearm and, possibly, also of the upper arm. Additional disparities in circumference are possible based on asymmetrical job physical requirements.

### 3. Reflexes

The biceps reflex primarily tests the C5 root, and to a lesser extent, the C6 root. The brachioradialis reflex tests the C6 root. The C7 root is assessed with the triceps reflex. The Hoffmann pathologic reflex in combination with clonus may indicate an upper motor neuron lesion.

### 4. Sensory Examination

Testing to light touch and pinprick (sharp dull perception) in the forearm and hand is usually sufficient to detect common nerve root compromise, but it may be necessary to perform sensory examination of the area from the neck to the forearm to test for higher nerve root compromise. Decreased sensation over the lateral deltoid muscle is a sign of C5 nerve root or axillary nerve compromise. Loss of sensation in the area of the radial forearm and thumb (and perhaps the index finger) suggests C6 nerve root involvement. Decreased sensation in the middle finger (3<sup>rd</sup> digit) may be a sign of C7 involvement, although it also is supplied occasionally by the C6 or C8 nerve root. The C8 root may show ring and little finger sensory findings. The ulnar side of the little finger (5<sup>th</sup> digit) is the purest area of C8 innervation. The T1 nerve root can be tested by evaluating sensation in the upper medial forearm and medial arm. The examiner should determine whether light touch can be felt, and whether the patient can distinguish between sharp and dull stimuli. These findings are more reliable than the report that sensory stimuli feel odd or “different” to the examinee, and yet each sensory stimulus is perceived (felt).

## 5. Physical Examination Tests

Ideally, the treatment of cervical or thoracic pain should be based upon a correct diagnosis. However, for most patients a specific diagnosis that indicates the pain generating structure and the pathophysiology is not possible, and their diagnosis is non-specific cervical pain. Physical examination rules out major neurologic involvement and provides a baseline from which to judge improvement over time. For a variety of reasons, a patient's response to a single test may not be reflective of the presence of identifiable underlying pathology.

## 6. Non-Organic Signs

Waddell articulated non-organic signs on physical examination of the lumbar spine in patients with probable psychosocial confounders and these signs have also been described in cervical spine patients.(121) However, they are not as well-known as Waddell's lumbar spine signs, and they have not been validated in multiple studies.

### *Evidence for Physical Examination/Medical History*

There is 1 high-quality RCT incorporated into this analysis.(99)

### **Early Disability Prevention and Management Issues**

See also the Cornerstones of Disability Prevention and Management guideline. As an example of the biopsychosocial model, initial patient management should include alertness to the presence or development of physical and psychosocial factors that may be barriers to recovery and, if not addressed, are thought to increase the probability of the development of delayed recovery or chronic pain.(122-125) Initial flags(126) drawing attention to these potential issues include excessive verbal attention to symptoms or physical features, inquiries about permanent impairment rating during an initial presentation, prior history of disability or impairment, familial members with acquired disabilities, a history of mental health disorders, history of substance(s) abuse, an apparent overreaction on examination, and presence of other non-organic physical examination signs. Besides the issues noted above, some additional yellow flags that the physician should consider include early signs of medication dependence, disproportionate inactivity, fear avoidance, compliance/attendance problems, resistance to transitional work options, and provider shopping.

Management of the patient at this stage of treatment necessitates overcoming these identified barriers in order to facilitate functional recovery and patient autonomy. Education is important, as there is evidence that when physicians view whiplash as a relatively benign condition their patients appear to consequently experience less debility.(127, 128) Therapies that are not resulting in functional recovery or that foster treatment dependence should be avoided. In contrast to the "watch and wait" philosophy, it is increasingly recognized that better outcomes are associated with maintaining work status or early return to work and avoiding or resolving disability at the earliest possible time. Patients should be encouraged to resume/continue normal basic and instrumental activities of daily within pain tolerance to minimize decline in function. These concepts reflect recognition that chronicity of disability is the overriding barrier to ultimate benefit for the injured worker. For example, the managing physician should consider early discontinuation of ineffective treatment and avoidance of interventional procedures of questionable significant functional benefit. For more difficult cases, referral for psychosocial evaluation and/or single-or-interdisciplinary treatment options with a proven record of success may be needed. For providers familiar with these management concepts, early referral (including after the first visit) to a physician well versed in the conservative management of cervicothoracic pain is recommended upon the discovery of these signs.

## C. Indications For Further Workup

Physical examination evidence of severe or increasing neurologic compromise that correlates with the medical history and test results may suggest a need for immediate referral. Suspicion of tumor, infection, fracture, dislocation, or other related serious conditions, warrants further investigation and usually urgent referral. A medical history that suggests pathology originating somewhere other than in the cervicothoracic spine may warrant examination of the shoulder, anterior neck, esophagus, heart, vascular system, lungs, upper abdomen, or other areas.

## Associated Factors, Risk Factors and Work-Relatedness

Episodes of acute cervical and thoracic pain are sometimes due to discrete trauma, (129) including some cases of work-related traumatic accidents. Most commonly these include effects of motor vehicle crashes, falls from height, and accidents involving being struck by an object. However, in the Mayo Clinic study of cervical radiculopathy cases occurring over 15 years, only 15% of cases had a history of physical exertion or trauma preceding the onset of symptoms. (130) Cases of cervical and thoracic pain that arise from crashes and falls occurring at work are not controversial and are considered work-related. Non-specific cervical pain may also arise as a sequel of a motor vehicle crash (e.g., whiplash). In most cases, work-relatedness of this condition is also

not controversial. However, there are some cases where work-relatedness becomes more unclear. Where the inciting event was low force, an activity done many times before without incident, and/or the condition continues beyond healing duration of an injury (does not behave like an injury) (131) particularly in the context of a pre-existing condition, work-relatedness is controversial.

## Individual Factors

Most cases of cervical and thoracic pain in the population do not arise from an acute injury or event and determining work-relatedness involves a more complex analysis that includes incorporation of the epidemiology on the subject as part of the causal assessment(132) (see Work-relatedness guideline). There is evidence for non-occupational risk factors for either non-specific cervical pain or persistence of pain, including increasing age,(129, 132-153) female gender,(136, 139, 140, 143, 144, 147, 148, 152-169) physical inactivity/lack of exercise,(139, 143, 163, 170) genetics,(171) poor sleep,(172-176) smoking/tobacco,(133, 134, 143, 148, 149, 152, 177-179) obesity,(144, 146, 175, 180-184) poor health,(151) episodes of sick leave,(185) metabolic syndrome,(186) and cardiovascular disorders.(187, 188) Most reports suggest no relationship between exercise and neck pain,(144, 148, 170, 182, 189) although a strong U-shaped relationship reported in low back pain raises concerns about appropriate statistical analyses in the neck pain studies(190) which is a further concern based on some comparable epidemiological evidence of a possible U-shaped relationship in the neck.(191) Prior neck, back pain, or other injury is a commonly reported risk.(132, 138, 143, 146, 147, 152, 155, 159, 192-194) Crystal diseases including gout, calcium pyrophosphate, and hydroxyapatite arthritides also are known to affect the spine.(195-197)

Poor labor market attachment and unemployment predict worse outcomes in those who subsequently sustain whiplash.(198) Lower baseline work activities also are predictive of worse outcome among acute whiplash patients,(157) as are higher baseline pain or disability scores,(135, 140, 157, 199-203) delay in seeking treatment;(140) treatment with physical therapy;(204) compensation or litigation status.(140, 202)

## Psychosocial and Work Organizational Factors

Psychosocial factors have been evaluated in many studies, with some reporting that these factors appear to outweigh job physical factors,(205-209) though some have found job physical factors to be modestly stronger.(210) Problems of inadequate recall of prior psychological, drug and alcohol issues have been reported.(211) Robust conclusions regarding relative importance of these factors are suggested to require quality epidemiological studies that include measured job physical factors. Available studies have suggested increased risks with depression,(128, 143, 149, 159, 181, 212-216) anxiety disorders,(149, 214, 215, 217, 218), stress,(219, 220) somatization,(157, 221) sexual abuse, psychiatric problems,(178) psychological stress,(163, 222) low occupational position,(223) workplace bullying,(175) low decision authority,(224), low social support,(152), emotional exhaustion,(175), distress,(212, 225, 226), self-efficacy,(227) high psychological demand,(132, 209, 225, 226, 228) high job strain,(137, 154, 155, 229-233) low job control,(210, 234) low supervisor support,(168, 209, 210, 235, 236) low empowering leadership,(228) low social support,(132, 229, 232, 235, 237) low occupational position,(223) job dissatisfaction,(166, 205, 230, 238, 239) effort-reward imbalance,(206, 208, 240) and generally reduced productivity.(241)

One study of chronic whiplash patients suggested it is frequently accompanied by wider spread of symptoms and is a functional somatic syndrome.(242) However, another study of whiplash patients found no predictive value of psychosocial variables studied(243) while another found childhood personality did not predict subsequent risk.(244) Stress biomarkers have also been identified as potentially predictive.(245, 246) Cultural factors are also reported to influence disability.(247, 248)

## Job Physical Factors

The occupational epidemiological literature base underlying cervical disorders is considerably weaker than for the lumbosacral spine.(232) Many studies combined shoulder and cervical pain, resulting in substantial difficulties in applying any of those studies to an individual case of any single disorder.(249, 250) There are no prospective cohort studies reported that have measured job physical tasks while frequently following workers over time to ascertain potential causal relationships. The relatively few longitudinal studies largely relied on self-reported exposures and infrequent assessments of health status, precluding strong conclusions.(133, 145, 152, 155, 166, 171, 185, 192, 205, 209, 231, 233, 251-260) The vast majority of reported studies have utilized retrospective methods, especially cross sectional study designs, and/or recall of job exposures through questionnaires. There is no validated ergonomic job exposure tool for the cervical spine, and available measures are considerably weaker than for the lumbar spine.

The available data on the importance of job physical factors include substantial conflicts. In contrast with beliefs that manufacturing and/or manual work is the greatest risk for neck disorders, National Health Interview Survey data, a large

population-based study found the highest prevalence of neck pain was in the military; arts, design, entertainment, sports, media; life, physical, and social science; health care support; and installation, maintenance, and repair.(261)

A number of physical factors have been reported to be associated with cervical pain in the body of available studies. Force was associated with cervical pain in some studies,(134, 146, 210, 262-266) while others have been negative.(267-270) Repetition has been found associated with cervical pain in some studies,(139, 185, 262, 271-278) though some also are negative.(267-269, 279) Posture has been associated with cervical pain in some studies,(134, 139, 210, 230, 262-264, 274, 275, 277, 280-286) while others have reported no association.(287-289) Prolonged sitting(185, 230, 233, 238, 290) and whole body vibration are also suggested contributors and vibration is further reviewed below. High “physical workload” or “mechanical exposure” has also been reportedly associated with increased risk,(155, 166, 171, 209, 291) while lower job physical demands were purported risks in another study,(204) but no relationship with job physical demands in others.(129, 292, 293) These activities are not exclusive to job functions and must be reviewed as they pertain to non-occupational activities as well. Unaccustomed work, hobbies, or sports (although there is some evidence to suggest that cycling may contribute to neck pain(294)) is largely unstudied in the cervical spine.

It has been theorized that the job physical “stressors” do not cause spine disorders, including cervical pain. Rather, when a disorder arises in an individual who does heavy physical work, the work is then more difficult to accomplish and the individual is more likely to file a workers’ compensation claim. This is compared to the sedentary worker who develops back pain and may continue to perform work though more carefully without need to file a claim (reporting bias).(295, 296) Prospective cohort studies have been underway for the lumbar spine to attempt to determine which of these theories (or both) are correct. Whether these results apply to the cervical spine is yet to be determined.

There have been postulates that whole body vibration is a risk for spine disorders(156, 249, 266, 297-306) and one author noted a risk for radiculopathy from segmental vibration.(307) However, there are many study weakness issues in the available data which are mostly from older studies, addressed only the lumbar spine and involved remote, higher amplitude exposures to equipment that is believed to be substantially different from that available today, did not control for known confounders, and generally did not control for time spent seated, which may cause fatal confounding.(308) There are far fewer data for cervical, or especially thoracic outcomes,(134, 156, 238, 249) and no consensus there is an increased risk for those spine segments. One study found no relationship with neck pain or problems.(309) Additionally, heavy material handling tasks involving loading or unloading, as well as the requirement for prolonged sitting(185, 230, 233, 238, 290) appear likely to have partially, but may have completely confounded data in the available studies on risks of whole body vibration.(310)

## Cervical Radiculopathy

Population-based data from Mayo Clinic indicate that cervical radiculopathy risk peaks among those 50-54 years of age, is more common among men than women, is disproportionately preceded by lumbar radiculopathy in 41% of cases, and is preceded by a specific discrete or traumatic event in only 15% of cases.(130) Other studies have reported associated factors include increased age,(299, 311-313) female gender,(313, 314) male gender,(299) white race,(313) smoking,(312, 315) obesity,(316) degenerative lumbar spine conditions,(311, 317) and degenerative thoracic spine conditions.(312) Some have noted the apparent predominance of cardiovascular risk factors (smoking, diabetes, hypertension, hypercholesterolemia, family history for premature myocardial infarction) for lumbar disc herniations which might also apply to the cervical spine.(318) Lumbar radiculopathy studies should likely be considered for systemic risks such as smoking.

Cervical radiculopathy has been relatively unstudied in occupational epidemiological studies.(249, 319-322) Most researchers have assumed there is some increased risk from heavy lifting, similar to the beliefs about lumbar spine risk resulting from increased intradiscal pressures from lifting. However, quality epidemiological data supporting these theories have not been published and available data conflict. There are studies that have reported no increased risk among workers performing data entry,(284) industrial workers,(271) shipping dockers,(323) and assembly line packers.(270) There are some reports of increased risk in fighter and helicopter pilots,(324) though not all report increase neck issues in these populations.(325) A population-based study from Denmark suggested professional drivers were at increased risk.(156)

## Degenerative Cervical Spine Conditions

Similar to disc herniations, degenerative findings in the lumbar and cervical spine are well correlated.(311) Development of degenerative cervical spine conditions on MRIs over 10 years were related to age, but not to sex, smoking, BMI, alcohol or sports/exercise.(150) Other studies have also suggested relationships with age(311, 326) and genetics.(327, 328) Passive coping has been shown to be a strong risk for disabling neck pain.(329) One study of carrying loads on the head in Nigerian traders found a link with spondylosis,(330) although extension of that activity to other typical western occupations is unknown.



No quality epidemiological studies support the theory that degenerative spondyloisthesis, spinal stenosis, or degenerative facet disease are occupational conditions. However, there is a biomechanical theory that physical factors may contribute through degenerative disease in the discs, with theoretically altered biomechanical forces in the facets resulting in or accelerating degenerative facet osteoarthritis. Yet osteoarthritis is now recognized to have strong relationships with genetics and age.(331)

## Thoracic Spine Pain

There are few studies of either thoracic pain or thoracic radicular pain. MRI data suggest significant correlations between having cervical degenerative findings and also having degenerative thoracic spine conditions,(312) which by extension suggests systemic risk factors operate throughout the spine (see Neck/Cervical above and Low Back Disorders guidelines). One study found approximately two-times higher prevalence of thoracic spine pain in women than in men. That study also reported lower grade male white-collar workers were more likely to report thoracic pain while upper grade female white-collar and professional workers were more likely to report thoracic spine pain.(332)

There is an absence of quality epidemiological prospective data with measured individual, job and psychosocial factors regarding thoracic pain and thoracic radicular pain.(333) It is recommended that the data on lumbar pain be utilized to help guide a tentative assessment of work-relatedness (see Low Back Disorders guideline), although in the absence of data, it should be recognized a clear conclusion of work-relatedness is speculative outside of discrete, significant trauma (see Work-Relatedness guideline).

## Follow-up Visits

Patients with potentially work-related acute cervicothoracic disorders are recommended [**Recommended Insufficient Evidence (I)**] to follow-up from every 3 to 5 days for acute severe conditions particularly with lost time injuries. Follow-ups may be needed less frequently, e.g. every 1 to 3 weeks for mild conditions without lost time and are **Recommended, Insufficient Evidence (I)** to be with a health care provider who can offer counsel regarding activity levels, relative rest, medication use, activity modification, prognosis, fear avoidant belief training, and other concerns.(334) Health care providers should answer all questions and make these sessions interactive so that the patient is fully involved in his or her recovery. If the patient has returned to work, these interactions may be conducted on site or by telephone to avoid interfering with work activities. Subsequent follow-up can occur when there is need for altered treatment; release to modified-, increased- or full-duty; or after appreciable healing or recovery can be expected. Typically, this will be no later than 1 week into the acute pain period. At the other extreme, in the stable chronic cervicothoracic spine pain setting, follow-up may be infrequent, such as every 6 months by consensus.

## Diagnostic Criteria

The criteria presented in the Diagnostic Criteria for Non-red Flag Conditions table (Table 5) 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*	Tests/Results
<b>Acute Cervical Pain</b> (Cervical strain/sprain, or Non-specific cervical pain, or “whiplash”)	Occurs commonly without an apparent event or may be associated by patient with a normal activity unlikely to cause harm.  May be temporally associated with a slip or fall, a motor vehicle accident, lifting, or forceful pushing and/or pulling.	Cervical pain that may or may not radiate to the scapula or deltoid and/or biceps area of the shoulder. Stiffness (decreased motion). Generally without paresthesias.	Exam may be normal or show decreased neck motion and/or superficial tenderness. No neurologic deficit.	<b>Not recommended in first 4-6 weeks unless history suggests a possible red flag condition.</b>

Probable Diagnosis or Injury	Mechanism	Symptoms	Signs*	Tests/Results
<b>Chronic Cervical Pain</b> (non-specific cervical pain or “chronic whiplash, cervical spondylosis, or pain of presumably disc, facet, or muscular/fascial origin)	Persistence of non-radicular cervical pain beyond 3 months.	Persistence of acute symptoms	Exam may be normal or show decreased neck motion and/or superficial tenderness. No neurologic deficit.	Not recommended
<b>Cervical Nerve Root Compression with Radiculopathy</b>	May occur without any obvious inciting event.  May be associated with lifting or trauma.	Arm pain with or without cervical pain. Paresthesias (numbness) are common. C5 and C6 nerve root syndromes are most common.	Dermatomal sensory alteration, myotomal strength and reflex alteration.  Foraminal closing (Spurling’s) and opening (traction) maneuvers increase/create or decrease arm symptoms.	MRI
<b>Spinal Cord Compression with Myelopathy</b>	Nearly always occurs in the setting of congenital cervical stenosis. Symptoms often insidious and may onset without any obvious inciting event.	Chronic cervical pain. May or may not have arm symptoms.  Impaired upper and/or lower limb coordination, with or without altered gait.  Bowel or bladder control impairment.	Pathologic reflexes (Babinski, Hoffman, etc.) Hyper-reflexia below level of cord compression.  Impaired rapid alternating movements and/or gait.  Other neurological impairment(s) (e.g., motor, sensory, bowel/bladder dysfunction)	MRI, CT Myelography

\*For patients with severe disorders, the physical examination can be quite helpful. However, for most patients with cervical pain, the physical examination findings tend to have low predictability.

## Diagnostic Tests

### Roentgenograms (X-Rays)

This review focuses on patients presenting to office based medical practices, and not on patients presenting to emergency rooms, and especially not to patients presenting by ambulance after major trauma.

X-rays demonstrate bony structure. Standard film views are generally an anterior-posterior (AP) film, and a lateral film. Oblique views give an excellent view of the neural foramina, and can strongly suggest foraminal stenosis. A coned-down or focused view of the odontoid may be included particularly for evaluation of traumatic or rheumatoid arthritis cases. Flexion and extension films are not standard films, but are occasionally used to evaluate spinal instability, particularly in the setting of rheumatoid arthritis, degenerative spondylolisthesis, and fractures. The criteria for cervical instability are a measurement of 4mm<sup>iv</sup> or more of movement of one vertebral body in relation to an adjacent vertebral body, or angular motion at one interspace that is 12 degrees or more greater than the motion at either the level above or below. (104, 335) Depending on the translation forward or backwards this is referred to as anterolisthesis or retrolisthesis.

1. *Recommendation: X-ray for Acute Cervicothoracic Pain with Red Flags or Subacute or Chronic Cervicothoracic Pain*  
**X-ray is recommended for acute cervicothoracic pain with red flags for fracture or serious systemic illness,(336) subacute cervicothoracic pain that is not improving, or chronic cervicothoracic pain.**

*Indications* – Patients with red flags (e.g., dangerous mechanism of injury, over age 65 years, paresthesias in extremities). Also indicated for subacute or chronic cervicothoracic pain particularly when not improving as an option to rule out other possible conditions. (336)

*Frequency/Duration* – Obtaining x-rays once is generally sufficient. Repeat films are usually reserved for significant changes in clinical status, i.e., significant worsening of existing symptoms or development of new symptoms.

<sup>iv</sup>Test says >3.5mm, but since no one can measure 0.5mm, this really means 4mm or more.

*Harms* – Medicalization or worsening of otherwise benign spine condition. Radiation exposure.

*Benefits* – Diagnosis of a fracture, cancer or otherwise latent medical condition(s).

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

*Level of Confidence* – **High**

2. *Recommendation: X-ray for Spondylolisthesis*

**Flexion and extension views are recommended for evaluating symptomatic spondylolisthesis in which there is consideration for surgery or other invasive treatment or occasionally in the setting of minimal trauma.**(337)

*Indications* – Chronic severe mechanical pain suspected to be due to instability.(337) Assessment is to measure the (dis)continuity of the spinolaminar line, along the posterior line of the vertebral bodies, and measured soft tissue diameters at C2 and C7.

*Frequency/Duration* – Flexion and extension views are generally needed no more than every few years. An experienced reader with an established protocol is recommended to avoid variation in interpretation.(337) However, after surgical intervention, flexion/extension views may be used to assess extent of successful fusion.

*Harms* – Medicalization or worsening of otherwise benign spine condition. Radiation exposure.

*Benefits* – Diagnosis of significant spondylolisthesis that is amenable to surgical correction.

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

*Level of Confidence* – **Moderate**

3. *Recommendation: X-ray for Acute, Non-specific Cervicothoracic Pain*

**Routine x-ray is not recommended for acute, non-specific cervicothoracic pain.**

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

*Level of Confidence* – **High**

## Rationale for Recommendations

There are few quality studies of x-rays, likely due to reliance on the test for many decades. X-rays are believed to be unnecessary for the routine management of cervicothoracic pain outside of the setting of red flags.(335, 336, 338) When red flags are identified, x-rays at the first visit are recommended to assist in ruling out these possible conditions (fracture, neoplasias, infection).(336) A clinical prediction rule was developed for alert and stable acute cervical trauma patients with a recommendation for x-rays if there is a dangerous mechanism of injury, age over 65 years, or accompanying paresthesias in the extremities. In the absence of red flags and if the patient is able to rotate the neck 45° both left and right then radiographs are not indicated.(336) Even when red flags are suspected, judgment is recommended and it should not be mandatory to order x-rays in all cases (e.g., significant typical cervicothoracic pain in the course of a manual patient transfer in a patient with a remote history of cancer). In the event there is cervical pain without any improvement over 4 to 6 weeks, x-rays may be recommended to rule out other possible problems.(335) If an MRI is used as imaging, plain x-ray may not be needed. MRI is a more sensitive and specific test particularly for disc-related concerns.

A prospective study examined inter-rater reliability in interpretation of flexion extension x-rays of the cervical spine. Three orthopedic surgeons, one neurosurgeon, and 3 radiologists blindly read the same 75 flexion extension x-rays for instability. The same x-rays were re-read in a different order from 28 to 183 days later using a computer assistant program. The first read resulted in 12/75 (16%) unanimous agreements. The second reading resulted in 57/75 (76%) unanimous agreements. It was concluded that there was a need for standardization and quantitative definitions of spinal instability and spinal fusion.(337)

X-rays are non-invasive, low to moderately cost, and have a low risk of adverse effects (exposure to ionizing radiation, which has been estimated to be from 0.12 and 0.02 mSv for AP and lateral cervical x-rays respectfully).(339) Thus, x-rays are recommended for discrete clinical situations.

## Quality Evidence

There is 1 moderate quality and 1 other study incorporated into this analysis.(336, 337)

*A comprehensive literature search was conducted using PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: neck, neck pain, cervical, radicular pain or radiculopathies, neck pain diagnosis, diagnostic, diagnosis, sensitivity, specificity, positive and negative predictive value, predictive value of tests, efficacy, efficiency; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*,*

randomized, randomization, randomly; systematic, retrospective studies, or prospective studies. We found and reviewed 240 articles in PubMed, 2 in Scopus, 48 in CINAHL, 0 in Cochrane Library and 0 in other sources. We considered for inclusion 2 articles from PubMed, Scopus, CINAHL, Cochrane Library and from other sources.

## Magnetic Resonance Imaging (MRI)

Magnetic resonance imaging (MRI) is considered the gold standard in diagnostic imaging for defining soft tissue anatomy due to its greater ability to distinguish soft tissues.(340-343) Thus, MRI is recommended to assess potential nerve root or spinal cord compression, if the patient is a candidate for surgery or radiation therapy, and if no contraindications to MRI exist. Computerized tomography (CT) remains an important analytical tool especially for evaluating bony or calcified structures.(340, 341, 344, 345) MRI may also be useful in the acute trauma setting to evaluate for soft tissue injury in non-communicative patients with a high pre-test probability of significant injury that would need intervention.(340, 344, 345) MRI also can determine if a fracture seen on x-ray is recent (still has marrow edema) or remote (healed and without marrow edema).

### 1. Recommendation: MRI for Diagnosing Red Flag Conditions

**MRI is recommended for patients with:**

1. **Acute cervical pain with progressive neurologic deficit;**
2. **Significant trauma with no improvement in significantly painful or debilitating symptoms;**
3. **A history of neoplasia (cancer);**
4. **Multiple neurological abnormalities that span more than one neurological root level;(340, 344-347) Previous neck surgery with increasing neurologic symptoms;**
5. **Fever with severe cervical pain; or**
6. **Symptoms or signs of myelopathy.**

*Harms* – Medicalization or worsening of otherwise benign spine condition.

*Benefits* – Diagnosis of a surgically treatable condition or otherwise latent medical condition(s).

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

*Level of Confidence* – **High**

### 2. Recommendation: MRI for Diagnosing Subacute and Chronic Radicular Syndromes

**MRI is recommended for patients with subacute or chronic radicular pain syndromes lasting at least 4 to 6 weeks in whom the dermatomal and myotomal symptoms are not trending towards improvement if either injection is being considered or both the patient and surgeon are considering surgical treatment if supportive findings on MRI are found.(343)**

*Harms* – Medicalization or worsening of otherwise benign spine condition.

*Benefits* – Diagnosis of a surgically treatable condition or otherwise latent medical condition(s).

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

*Level of Confidence* – **High**

### 3. Recommendation: Early MRI for Diagnosing Acute Radicular Syndrome

**MRI is not recommended for acute radicular pain syndromes. Exceptions include progressive neurologic deficit (see above) or severe impairment not trending towards improvement and either injection is being considered or both patient and surgeon are willing to consider early surgical treatment if supportive findings on MRI are found.**

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

*Level of Confidence* – **Moderate**

### 4. Recommendation: Repeat MRI Imaging without Significant Clinical Deterioration in Signs and/or Symptoms

**Repeat MRI imaging in the absence of significant new radicular or myelopathy symptoms and/or signs is not recommended. An exception would be agreement on the part of the patient and surgeon that surgery will be performed, and the previous MRI is more than 6 months old. Cervical disc herniations are known to resorb spontaneously, and surgery would be predicated on persisting nerve root or cord compression.(348)**

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

*Level of Confidence* – **Moderate**

### 5. Recommendation: MRI for Diagnosing Non-specific Cervicothoracic Pain

**MRI is not recommended for the evaluation of patients with non-specific chronic cervicothoracic pain. MRI may be considered if the purpose is to rule out non-injury-related diagnoses in select patients, such as possible neoplasia, infection, or other neurological illnesses, based on the presence of symptoms or findings that suggest these diagnoses.**

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

*Level of Confidence – Moderate*

6. *Recommendation: Flexion/Extension, Standing, or Weight-bearing MRI*

**Flexion/extension, standing, or weight-bearing MRI is not recommended for cervicothoracic pain or radicular pain syndrome as the clinical utility of this technology has not been adequately established.**

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

*Level of Confidence – Moderate*

7. *Recommendation: MRI for Acute Whiplash without Neurological Signs*

**MRI is not recommended for patients with acute whiplash in whom there is no evidence of dermatomal or myotomal symptoms and signs.**

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

*Level of Confidence – Moderate*

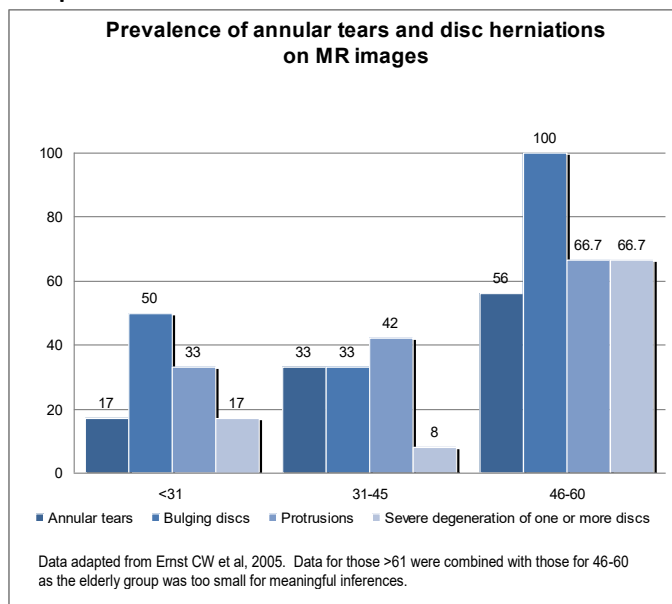
8. *Recommendation: Open MRI*

**Open MRIs are not recommended for routine use except in circumstances where the patient is either morbidly obese and exceeds the closed MRI unit’s weight specifications, or suffers from claustrophobia that is not alleviated with a low-dose anxiolytic administered prior to the procedure.**

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

*Level of Confidence – Moderate*

**Figure 1. Prevalence of Asymptomatic Annular Cervical Tears and Cervical Disc Herniations on MR Images by Three Age Groups**



**Rationale for Recommendation: Closed MRIs**

MRI has been evaluated in quality studies (see evidence table); however, most cases of cervicothoracic pain and radicular pain syndromes spontaneously resolve and require no imaging.(349-351) The sensitivity and specificity of MRI or CT are difficult to define as they require a “gold standard” that is difficult to define in spine pain since the final diagnosis often is based on the same imaging modality being tested. Therefore, these clinical studies may be prone to incorporation bias, artificially inflating the sensitivity and specificity with some assuming MRI has 100% sensitivity and specificity. Multiple case series have been reported in patients with acute cervicothoracic trauma with neurologic deficits. A retrospective review evaluated MR and CT scans in 113 acute spine trauma patients. The study reported on a total of 166 lesions found on MRI and CT scan. MRI was reported to be superior to CT scan in finding soft tissue injury, ligamentous injury, high-grade stenosis, and spinal cord injuries.(347) A case series evaluated MRI and CT scans in 14 spinal trauma patients. They reported that CT missed 3 epidural hemorrhages (100%)

found on MRI, and CT missed 3 of 5 (60%) intervertebral disc injuries found on MRI.(345) It has been shown that MRI is superior to CT scan and x-ray at identifying spinal cord injury and other soft tissue injuries.(340, 344-347, 352, 353)

A study evaluating 52 cervical radiculopathy patients with or without myelopathy reported that MRI was in agreement with the surgical findings 74% of the time. When MRI and CT myelography were conducted on the same patient, the radiographic diagnosis was in agreement with the surgical diagnosis 90% of the time.(343)

A study with 497 asymptomatic patients was conducted. An overall increase of MRI findings related to age ( $p < 0.0001$ ) was reported. Grade 1 or Grade 2 disc degeneration was found in 17% of the discs in asymptomatic men and 12% of the discs in asymptomatic women in their twenties rising to 86% and 89%, respectively, in subjects over 60 years of age.(354) A study evaluated MRI findings in a cohort of high school students with or without cervicothoracic pain. They initially surveyed students about symptoms while they were in high school. Seven years after the first survey was completed another survey was done. The participants with cervicothoracic and shoulder pain on both occasions but without significant changes over the years were chosen as the symptomatic group. Participants without cervicothoracic or shoulder pain at both survey times were the asymptomatic group. Participants had an MRI done at the end of the 7 years follow-up. Pathological changes of the cervical spine seen with MRI in 24 to 27 years old were reported to be equally common in the symptomatic and asymptomatic groups; 20 degenerated discs in the symptomatic group (SG) and 26 in the asymptomatic group (AG); 14 annular tears in the SG, 18 in the AG; 18 disc protrusions in the SG, and 29 in the AG. Disc herniations were the only finding more prevalent in the symptomatic group, 4 in the symptomatic group and 0 in the asymptomatic group.(355)

A prospective study evaluated MRI scans in acute whiplash patients at baseline and after 3 months. Each patient was involved in a RCT evaluating immobilization, active mobilization and advice to act as usual. The initial MRIs were performed on 178 patients and follow up MRIs on 82 (46.1%) patients. The most frequent finding was pre-existing degeneration 139/178 (78%). Bulges or protrusions of one or more discs were present in 35/178 (20%) of the participants. It was determined that 7 had findings on MRI that were “traumatic” in nature (paravertebral bleeding/edema, prevertebral bleeding/edema, edema in the spinal cord, or “traumatic” disc protrusion or bulge). The authors concluded that MRI is not the answer to a diagnosis in the vast majority of patients developing long-lasting pain after a whiplash injury, and early MRI scans do not predict prognosis.(356) Others have reported evidence of fatty infiltrates in the craniocervical flexors being statistically higher on MRI in those with chronic whiplash disorders.(353) However, a prospective, 10-year study has reported MRI findings do not explain persistent symptoms.(357)

Another study evaluated MRI findings in relation to the transverse ligaments of the atlas (alar ligaments). The study evaluated 92 whiplash-injured patients diagnosed as Grade 2 whiplash patients and 30 uninjured individuals who underwent proton density-weighted MRI of the craniovertebral junction at least 2 years after the injury. Twenty out of 117 (17.1%) had Grade 2 or 3 posterior atlanto-occipital membrane lesions. No Grade 3 lesions and only one Grade 2 lesion was found in the uninjured individuals. However, no clinical correlation was made in regard to prognosis or symptoms based in the MRI findings.(358) In another study using the same populations it was reported that the transverse ligament was classified as abnormal in 64% in the injured group and 27% of the uninjured group.(358) The authors failed to explain why the alar ligament should show signs of acute injury (increased signal) 2 to 9 years after the whiplash event in spines that are not clinically unstable. Other investigators did not find MRI evaluation of the alar ligaments clinically helpful due to the high prevalence of “abnormalities” in normal people.(359, 360)

There is no quality evidence for use of MRI within the first 6 weeks of symptom onset. However, rare cases are thought to need MRI and emergent/urgent surgery (see below).(343) Patients presenting with a mild single nerve root deficit, such as an absent deep tendon reflex, should not have early MRI, as their condition usually resolves spontaneously; thus, the test does not alter the course of treatment. Those who have a documented neurologic status that then objectively deteriorates (particularly a significant increase in weakness or an increased loss of sensation compared with the prior examination) and those with a history of cancer with symptoms suggesting atypical radicular presentation do have an indication for early imaging with MRI.

In the absence of red flags suggesting fracture or serious systemic illness, imaging before 6 weeks produces no clear health outcomes benefit.(355, 356, 361-364) Early imaging would be expected to result in higher overall costs and increased morbidity through the performance of some unnecessary procedures and/or surgeries. Disc degeneration, disc bulging, and endplate changes on MRI have been shown to either not correlate at all or correlate poorly with clinical outcomes, suggesting that MRI is not useful for most patients.(340, 341, 354-356)

Patients should be *a priori* informed that their MRI is highly unlikely to be “normal” as few patients have a normal MRI(354), and there is a considerable rate of resolution of herniations over 6 weeks after an initial MRI documented in the lumbar spine (see

Low Back Disorders guideline). A patient handout describing the prevalence of “abnormal findings” on MRI of asymptomatic individuals is helpful. **Physicians lacking the time or knowledge to explain these facts to patients should avoid ordering MRIs.** The discovery of degenerative changes or clinically irrelevant disc herniations in many patients may cause them to focus on the need to “fix” MRI changes that are actually normal for their age or are asymptomatic findings.(354) This may also become a rationale for avoiding participation in the therapeutic activities that promote functional recovery. In addition, lack of understanding of the strengths, indications, and limitations of a technology preclude adequate clinical interpretation of the results. In those cases, consultation with a physician experienced in treating musculoskeletal disorders may be helpful.

A prospective, observational study using MRI preoperatively to predict postoperative recovery in 57 cervical spondylotic myelopathy (CSM) patients found MRI beneficial in predicting outcomes. The study found those with high T2SI and spinal cord failure were found to predict poorer recovery. Patients with low T1SI were predictive of greater impairment, and those with focal T2SI made more significant improvements in walking. However, the evidence of prognostic power for CSM patients is inconsistent.(365)

Open MRIs have lower ability to discern soft tissue without lower costs and are not recommended other than in circumstances where the patient is either morbidly obese and exceeds the closed MRI unit’s weight specifications, or suffers from claustrophobia that is not alleviated with a low-dose anxiolytic administered prior to the procedure.

MRI is minimally invasive even when contrast is used, has few adverse effects, but is high cost. MRI changes treatment if it detects unrecognized fracture, systemic disease, or a spinal condition for which surgery is the recommended treatment.

#### **FLEXION/EXTENSION, STANDING (“UPRIGHT” OR “POSITIONAL”) MRIs**

There are no quality trials or studies evaluating flexion/extension MRI or standing MRIs in cervicothoracic pain patients (see Low Back Disorders guideline).

### **Quality Evidence**

There are 3 high-(341, 366, 367) and 15 moderate-quality studies(340, 343-347, 352, 354-356, 358, 368-371) incorporated into this analysis.

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: magnetic resonance imaging, MRI, MRI scan, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, diagnostic, efficacy, efficiency, sensitivity, specificity, predictive value of tests, positive predictive value and negative predictive value. In PubMed, we found and reviewed 2,442 articles, and considered 8 for inclusion. In Scopus, we found and reviewed 186 articles, and considered 1 for inclusion. In CINAHL, we found and reviewed 68 articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed 78 articles, and considered zero for inclusion. We also considered for inclusion 11 articles from other sources. Of the 25 articles considered for inclusion, 17 studies and 8 systematic studies met the inclusion criteria.*

### **Electromyography**

Electromyography (EMG) is a physiological test that assesses the function of the motor unit (including the neuron’s anterior horn cell, its axon, the neuromuscular junctions and muscle fibers it supplies).(372, 373) It differs from surface EMG, which is discussed below. EMG technically refers to the needle electromyogram and the term “EMG” is usually misused as a euphemism for an electrodiagnostic exam that includes both needle EMG and peripheral nerve conduction testing. Among spine patients, EMG has been used primarily to evaluate radiculopathy.(374)

#### **1. Recommendation: EMG with Upper Extremity Symptoms**

**Electrodiagnostic studies, which must include needle EMG, are recommended where a CT or MRI is equivocal and there is ongoing upper extremity pain that raise questions about whether there may be a neurological compromise that may be identifiable (i.e., upper extremity symptoms consistent with radiculopathy, spinal stenosis, peripheral neuropathy, etc.).** Also, may be helpful for evaluation of chronicity and/or aggravation of a pre-existing problem.

*Indications* – Failure to resolve or plateau of suspected radicular pain without resolution after waiting 4 to 6 weeks (to provide for sufficient time to develop EMG abnormalities as well as time for conservative treatment to resolve the problems), equivocal imaging findings such as CT or MRI, and suspicion by history and physical examination that a neurologic condition other than radiculopathy may be present instead of, or in addition to radiculopathy.

*Harms* – Medicalization or worsening of otherwise benign spine condition. Pain. Hematoma. Misinterpretation if not done by an appropriately trained person.

*Benefits* – Diagnosis of neurological compromise.

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

*Level of Confidence* – **High**

2. *Recommendation: EMG without Upper Extremity Symptoms*

**Electrodiagnostic studies are not recommended for patients with acute, subacute, or chronic neck pain who do not have significant upper extremity pain or numbness.**

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

*Level of Confidence* – **Moderate**

## Rationale for Recommendations

Needle EMG may help determine if radiculopathy and/or spinal stenosis is present, and can help address acuity.(375) EMG requires full knowledge of the anatomy and precise innervation of each muscle to properly perform and interpret the test results. Needle EMG also requires the skills of an experienced physician who can reliably spot abnormal motor potentials and recruitment patterns. Nerve conduction studies are usually normal in radiculopathy (except, for example, for motor nerve amplitude loss in muscles innervated by the involved nerve root in more severe radiculopathy). Nerve conduction studies rule out other causes for upper limb symptoms (generalized peripheral neuropathy, pronator syndrome, etc.) that can mimic radiculopathy.

An abnormal EMG that persists after anatomic resorption of the herniation(376) and that correlates with the patient's symptoms is generally considered proof the symptoms are due to radiculopathy. Thus, the EMG study documents that management for chronic neuropathic pain appears appropriate.

As imaging studies (especially CT and MRI) have progressed, the need for EMG has declined. However, EMG remains helpful in certain situations. These include ongoing pain suspected to be of neurological origin, but without clear neurological compromise on imaging study. EMG can then be used to attempt to rule in/out a physiologically important neurological compromise. An abnormal study confirming radiculopathy permits a diagnosis of neuropathic pain (helping with pain management decisions). This test should not be performed in the first month unless there is a desire to document pre-existing neurological compromise, as it requires time (generally at least 3 weeks) to develop the needle EMG abnormalities. EMG is minimally invasive, and has no long-term adverse effects (although it is somewhat painful), and it is costly. To result in reliable measures, it must be performed by a practitioner well skilled in the appropriate anatomy and testing procedures. Post-operative changes may persist in normal individuals without clinical significance, thus also requiring careful interpretation.

## Evidence for the Use of Electromyography

There are no quality studies regarding the use of electromyography.

*We searched PubMed and Google Scholar without limits on publication dates. We used the following search terms: Surface Electromyography, sEMG, neck pain [MESH] and Diagnostic to find 99 articles. We reviewed 99 articles and included 0 articles.*

## Surface Electromyography

Surface electromyography (sEMG) has been used to diagnose spine pain, especially in the lumbar spine (377-393) and involves the recording of summated muscle electrical activity by skin electrodes (such as those used in an electrocardiogram or EKG). Unlike traditional needle EMG (see above), no needle is used to explore specific portions of specific muscles for motor unit potentials.

*Recommendation: Surface EMG for Diagnosing Cervical or Thoracic Pain*

**Surface EMG is not recommended to diagnose cervical or thoracic pain.**

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

*Level of Confidence* – **High**

## Rationale for Recommendation

There are no quality studies demonstrating that use of surface EMG results in improved diagnosis or evaluation of patients with cervical or thoracic pain. Available studies in the lumbar spine have methodological weaknesses, including poor



descriptions of patients, small sample sizes, types of machine, electrode placement, and analysis of the output making outcomes difficult to compare across studies.(379, 383, 389, 393, 394)

The American Association of Neuromuscular and Electrodiagnostic Medicine’s position is that there are no clinical indications for the use of sEMG in the diagnosis and treatment of disorders of nerve and muscle, although potential future uses are possible.(395, 396) Surface EMG is not invasive, has few adverse events, is moderately costly, but has a lack of quality evidence of benefits for the clinical evaluation or treatment of spine disorders and thus is not recommended.

## Evidence for the Use of Surface Electromyography

There are no quality studies regarding the use of surface electromyography.

*We searched PubMed and Google Scholar without limits on publication dates. We used the following search terms: Surface Electromyography, sEMG, neck pain [MESH] and Diagnostic to find 99 articles. We reviewed 99 articles and included 0 articles.*

## Discography

Discography is a diagnostic test that attempts to determine if chronic spinal pain is originating from the intervertebral disc.(397-405) A needle is inserted into the middle (nucleus pulposus) of a disc and x-ray dye is injected. Images are then made, often with both x-rays and computed tomography (CT).(397, 400, 401, 406, 407) Discography is usually used in patients with chronic spinal pain without significant extremity pain.(401) This procedure is fairly painful and sedation is required.(400, 401, 408-410) Unlike in the lumbar spine, extravasation of contrast out of the disc is not considered a significant finding in cervical discography.(402, 411-413)

Discography proponents believe that discs with more severe degrees of degeneration are more likely to be painful.(397, 398, 400) If a patient does not experience pain on injection, that disc is considered unlikely to be the source of chronic spinal pain. If a patient experiences pain that is mild or that is clearly different in location or character to his or her chronic pain, that disc is also considered unlikely to be the source of chronic spinal pain.(400, 401, 405, 414) However, if the patient experiences significant pain that is identical in location and character to the patient’s chronic pain (“concordant pain”), proponents believe that discography can identify the pain-generating structure responsible for chronic spinal pain.(397-400, 407, 415, 416)

Discography has known complications including discitis, epidural abscess secondary to discitis, herniated cervical disc, and quadriplegia.(401, 413, 417-419) Discography has been shown to result in accelerated degeneration in the normal control discs that are injected in the lumbar spine,(420) and there is a suggestion that this is also true in the cervical spine.(421) The technique of discography is not standardized. There is no universally accepted definition of what constitutes a concordant painful response. There are no published intra-rater or inter-rater reliability studies on cervical discography. Discography is important to the subsequent discussions of spinal fusion for “degenerative disc disease,” and artificial disc replacement, as many North American surgeons (but not European surgeons) use discography results in surgical planning.(422) If discography can accurately identify a disc as the pain-generating structure, then surgical procedures on that disc may logically lead to patient improvement.(402, 423) If discography can produce pain, but cannot accurately identify that disc as the pain generating structure, then surgery on that disc is presumably unlikely to be helpful.(408, 418, 422) Due in part to recognition that discography is not a highly accurate test,(408, 411, 418, 422, 424) attempts have been made to modify the test to attempt to increase the accuracy, including measurement of pressures where pain occurs,(398, 407, 423) as well as injection of anesthetics.(400, 417, 425)

*Recommendation: Discography for Assessing Acute, Subacute, or Chronic Cervicothoracic Pain or Radicular Pain Syndromes*  
**Discography, whether performed as a solitary test or when paired with imaging (e.g., MRI, CT), is not recommended for acute, subacute, or chronic cervicothoracic pain or radicular pain syndromes.**

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

## Rationale for Recommendation

Discography has not been evaluated in high-quality studies for cervicothoracic pain. There is considerably greater evidence in the lumbar spine which suggests low positive predictive value of discography (see Low Back Disorders Guideline). There are several case series reports and a few comparisons between discography findings and findings on MRI. One case series evaluated 71 chronic cervicothoracic pain patients who had concordant pain responses with discography and then underwent

anterior cervical discectomy and fusion. The authors reported 93% excellent or good outcomes and 7% fair or poor surgical outcomes.(425) This is contrasted with another case series that evaluated 22 patients who had concordant pain responses to discography and then underwent anterior cervical discectomy and fusion. Excellent surgical outcomes were reported in 5%, 41% had a good outcome, 27% had a fair, and 27% had a poor surgical outcome. This study also reported a 13% complication rate including one patient who developed quadriplegia and concluded that discography's benefit in diagnosis did not outweigh the complication rates.(418)

A retrospective case series evaluated 42 surgical patients – all had cervical discography prior to surgery. The diagnoses given at discography were compared to diagnoses given after exploratory surgery. The overall diagnostic accuracy for cervical discography compared to surgical findings was 55%. Of 12 disc protrusions seen at surgery, 8 were identified by discography (66%). Of the 24 cases of spondylosis diagnosed at time of surgery, 12 were identified by discography (50%).(422)

A moderate-quality retrospective study evaluated concordant pain responses in chronic cervicothoracic pain patients without a comparison group and reported that out of 807 discs injected during discography 404 (50%) had concordant pain responses.(401) A study of 72 chronic cervicothoracic pain patients versus 72 controls with no cervicothoracic pain was conducted to evaluate sensitivity and specificity of discography and reported a sensitivity of 65% and specificity of 50%.(411) Thus, with a pre-test probability of 50%, these results suggest the positive predictive value would be 56.5%.

There are a few studies comparing cervical discography to MRI.(412, 413) Parfenchuck et al(413) examined 52 cervicothoracic pain patients who had failed conservative treatment. They performed spinal MRI from C2-T1 and noted abnormalities. They then performed discography on all patients. Of the 62 painful discs on discography, 45 were abnormal on MRI, constituting a sensitivity of 73% and false negative rate of 27% for MRI to detect discs that are painful with discography. Of the 42 asymptomatic discs on discography, 28 were normal on MRI constituting a specificity of 67% and false-positive rate of 33% for MRI for abnormalities on discs that are not painful on discography.

Another study examined 20 patients, 10 who had chronic cervicothoracic pain and 10 lifelong asymptomatic subjects. All 20 underwent discography at C3-C4 through C6-C7 after MRI. Disc morphology and provoked responses were recorded at each level. MR examinations were judged to be normal in 1 of the 10 asymptomatic patients (5 of the 40 discs injected in the asymptomatic patients were painful on injection). The study examined 80 discs in the 20 subjects. Of the 31 discs reported as normal on MRI, 27 had annular tears of varying degree. The authors concluded that MRI at the time did not reliably detect annular defects.(412) Seventy percent of the asymptomatic subjects had painful disc injections (4 or 5 on a 0 to 10 pain intensity scale), and 2 out of 10 had pain intensity 6 noted on injection. These studies may describe how likely a given finding on imaging is to be associated with pain on injection, but cannot determine whether the pain response is a true-positive or a false-positive response. Thus, these studies are not capable of guiding further therapy.

In low back pain, the estimated positive predictive value appears to be at or below 50%, suggesting the test is not helpful in the lumbar spine.(426) These studies have not found that discography reliably indicates which particular disc is the source of the patient's pain. Validity of those findings through improved operative successes is not consistently present.(427) Studies on imaging have shown that most imaging findings do not correlate with an individual's pain status(426) (see Low Back Disorders guideline).

Discography is invasive and has adverse effects. Temporary complications include headache, nausea, and worsened cervicothoracic pain. Uncommon, but serious reported complications include meningitis, epidural abscess, arachnoiditis, intrathecal hematoma, intradural injection of contrast, and acute disc herniation.(417, 418, 428) Discography results in a patient exposure to radiation of 1.5 to 4.0 rads.(429) Most concerning is the recent report that in long-term follow-up lumbar discography of the discs that are normal (the "negative control" discs) results in more rapid disc degeneration and an increased incidence of disc herniation.(211) Discography requires that one or two normal discs be injected and be painless on injection, so that the disc that is painful during injection can be identified. If discography iatrogenically damages the normal control discs, and does not lead to improved treatment outcomes, then there is clear evidence that discography should not be performed. A similar study has not been performed for cervical discography; however, Nassr reported a case series that is perhaps analogous. At the time of anterior cervical discectomy and fusion, surgeons traditionally verify they are about to operate on the correct level (remove the correct disc) by inserting a metal needle in the disc at the start of the operation, and then taking an intra-operative x-ray to verify the correct disc has been identified. Nassr reported a series of cases in which surgeons inserted a needle in the wrong disc (always the disc above the disc that was to be operated upon). In the short-term (2 years) follow-up, the "normal" disc above the level to have surgery showed faster than expected degenerative change.(421) Discography is also costly and has not been found to provide information that has sufficient positive or negative

predictive value to warrant its addition to the clinical examination or other testing currently under use. It is not currently recommended, although there are potential modifications to the procedure being further studied.

A recent systematic review did not find any high quality evidence to support cervical discography, and did not find any studies that show discography could improve clinical outcomes in patients considering cervical surgery.(98)

## Evidence for the Use of Discography

There are 13 moderate-quality studies and 2 other studies(401, 402, 408-413, 416-418, 422, 423, 425, 430) incorporated in this analysis. (There are also 20 studies included that focus on lumbar studies.(80, 367, 426, 431-447))

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: discitis, discography, diagnostic, efficacy, efficiency, sensitivity, specificity, predictive value of tests, positive predictive value and negative predictive value. In PubMed we found and reviewed 18 articles, and considered 15 for inclusion. In Scopus, we found and reviewed 30 articles, and considered zero for inclusion. In CINAHL, we found and reviewed one article, and considered zero for inclusion. In Cochrane Library, we found and reviewed 5 articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the 15 articles considered for inclusion, 15 studies met the inclusion criteria.*

## MRI Discography

MRI is sometimes paired with discography for evaluation of the intervertebral discs.

*Recommendation: MRI Discography for Evaluating Herniated Discs*

**MRI discography is not recommended for evaluating herniated discs.**

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

*Level of Confidence – Moderate*

## Rationale for Recommendation

There is no quality evidence supporting this combined test. The role of discography combined with MRI for evaluating herniated discs has not been determined. MRI discography is invasive, has adverse effects, and is costly. Therefore, it is not recommended.

## Evidence for the Use of MRI Discography

There are no quality studies incorporated into this analysis.

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: MRI discography, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, diagnostic, efficacy, efficiency, sensitivity, specificity, predictive value of tests, positive predictive value and negative predictive value. In PubMed, we found and reviewed 26 articles, and considered zero for inclusion. In Scopus, we found and reviewed 22 articles, and considered zero for inclusion. In CINAHL, we found and reviewed one articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed 5 articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the zero articles considered for inclusion, zero randomized controlled trials and zero systematic studies met the inclusion criteria.*

## Single Photon Emission Computed Tomography (SPECT)

Single photon emission computerized tomography or SPECT is a nuclear tomographic imaging technique using gamma rays.(448) SPECT scanning is a less invasive modality that has been used, for example to attempt to make the diagnosis of facet joint arthritis.(449)

*Recommendation: SPECT for Cervical and Thoracic Pain and Related Disorders*

**SPECT is not recommended for the evaluation of patients with cervical or thoracic pain and related disorders.**

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

*Level of Confidence – Low*

## Rationale for Recommendation

There is no quality evidence with patient-related outcomes that SPECT is helpful in improving care of acute, subacute, or chronic cervical pain, thoracic pain, or radicular pain syndromes or other spine-related conditions. Some data suggest SPECT may outperform bone scanning. Additional studies are needed to determine if SPECT adds something to the diagnosis, treatment and outcomes beyond that obtained by a careful history, physical examination, plain x-rays, and clinical impression before it can be recommended for evaluating, e.g., facet arthropathies.

## Evidence for use of Single Photon Emission Computerized Tomography (SPECT)

There are 2 moderate-quality studies incorporated into this analysis.(450, 451) There is 1 low-quality study in Appendix 1.(449)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Single-photon emission computed tomography, single-photon emission computerized tomography, SPECT, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, diagnostic, efficacy, efficiency, sensitivity, specificity, predictive value of tests, positive predictive value and negative predictive value. In PubMed, we found and reviewed 49 articles, and considered 3 for inclusion. In Scopus, we found and reviewed 7 articles, and considered zero for inclusion. In CINAHL, we found and reviewed 3 articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed 1 articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the 3 articles considered for inclusion, 3 studies and zero systematic studies met the inclusion criteria.*

## Functional Capacity Evaluations

The functional capacity evaluation is a set of tests, observations and practices that are combined to attempt to ascertain the ability of the patient to function most commonly either in one discrete job (e.g., return to work after injury) or potentially in a wide variety of different employment settings without targeting one in particular. A functional capacity evaluation is used to infer the work capacity.(452) A FCE may also be used to ascertain a baseline from which to develop a treatment program, to target specific work return to work needs.(453-455) The goals of FCEs include:

1. Determine individual's readiness to work after injury or illness at Maximum Medical Improvement (MMI),
2. Assist with goal-setting and treatment planning for rehabilitation or to monitor the progress of a patient in a rehabilitation program,
3. Estimate potential vocational status and provide a foundation for effective vocational rehabilitation,
4. Provide information to assist in disability determinations,
5. Provide information for hiring decisions (post-offer or fit-for-duty testing),
6. Assess the extent of disability in litigation cases, and
7. Provide information regarding a patient's level of effort and consistency of performance.

### 1. Recommendation: FCEs for Chronic Disabling Cervical or Thoracic Pain

**FCEs are a recommended option for evaluation of disabling chronic cervical or thoracic pain where the information may be helpful to attempt to objectify worker capability, function, motivation and effort vis-à-vis either a specific job or general job requirements.** There are circumstances where a patient is not progressing as anticipated at 6 to 8 weeks and an FCE can evaluate functional status and patient performance in order to match performance to specific job demands, particularly in instances where those demands are medium to heavy. If a provider is comfortable describing work ability without an FCE, there is no requirement to do this testing.

*Harms* – Medicalization, worsening of LBP with testing. May have misleading results that understate capabilities.

*Benefits* – Assess functional abilities and may facilitate greater confidence in return to work.

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

*Level of Confidence* – **Moderate**

### 2. Recommendation: FCEs for Chronic Stable Cervicothoracic Pain or Post-operative Recovery

**There is no recommendation for or against FCEs for chronic stable cervicothoracic pain or after completion of post-operative recovery among those able to return to work.**

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

*Level of Confidence – Low*

3. *Recommendation: FCEs for Acute Cervicothoracic Pain, Acute or Subacute Radicular Syndromes, or Post-Surgical Cervical or Thoracic Pain*

**FCEs are not recommended for evaluation of acute cervicothoracic pain, acute or subacute radicular syndromes, or post-surgical cervicothoracic pain problems within the first 12 weeks of the post-operative period.**

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

*Level of Confidence – High*

## **Rationale for Recommendations**

FCEs are one of the few means to attempt to objectify limitations and are frequently used in workers' compensation systems, particularly as the correlation between pain ratings and functional abilities appears weak.(456-462) Yet, obtaining objective data regarding spine problems is somewhat more challenging than for extremity-related impairments due to the degree of reliance on the patient's subjective willingness to exert or sustain major activities (e.g., standing, walking, sitting) that are critical for job performance. Because their reliability and validity have not been proven, FCEs should be utilized to evaluate work ability about what a patient was willing to do on a given day. They should not be used to override the judgment about the work ability of a patient with a back problem.

Many commercial FCE models are available. There is research regarding inter-and intra-rater reliability for some of the models (complete discussion is beyond the scope of this guideline). The validity of FCEs, particularly predictive validity, is more difficult to determine, since factors other than physical performance may affect return to work.(463, 464) An FCE may be done for one or more reasons, including identifying an individual's ability to perform specific job tasks associated with a job (job-specific FCE) and physical activities associated with any job (general FCE), or to assist in the objectification of the degree(s) of impairment(s). The type of FCE needed, and any other issues the FCE evaluator needs to address, should be specified when requesting a FCE.

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

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

- Patient interview including:
  - Informed consent
  - Injury/illness and medical history
  - Current symptoms, activities and stated limitations
  - Pain ratings/disability questionnaires
- Musculoskeletal examination (e.g., including Waddell's non-organic signs)
- Observations throughout the session (e.g., demonstrated sitting tolerance, pain modifying behaviors)
- Material handling tests (lifting, carrying, pushing, pulling)
- Movement tests (walking, crouching, kneeling, reaching, etc.)
- Positional tolerance tests
- Dexterity/hand function
- Static strength (varies among models)
- Aerobic fitness (usually submaximal test-also variable among models)
- Job specific activities as relevant
- Reliability of client reporting (e.g., non-organic signs, pain questionnaires, placebo tests, etc.)
- Physical effort testing (e.g., Jamar Dynamometer maximum voluntary effort, bell curve analysis, rapid exchange grip, competitive test performance, heart rate, observation of clinical inconsistencies, etc.)

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

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

The best studies on the ability of FCEs to predict safe re-entry to the workplace following rehabilitation of work-related back pain/injury suggest that FCEs are not able to predict safe return to work (concurrent validity).(465-467) In a prospective cohort study of 1,438 consecutive work-related back patients, all underwent a FCE prior to return to work. In the control group, the FCE was used to write return-to-work guidelines, while in the study group it was ignored and the worker was returned usually to full duty. Ignoring the FCE reportedly improved outcomes in a 1994 study, although the results have not been duplicated(468) and the quality of an FCE is believed to be heavily dependent on the skill, knowledge and experience of the FCE evaluator.(469)

## Evidence for the Use of Functional Capacity Evaluation

There are 2 moderate-quality studies incorporated into this analysis.(454, 470)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Functional capacity evaluation, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, diagnostic, efficacy, efficiency, sensitivity, specificity, predictive value of tests, positive predictive value and negative predictive value. In PubMed, we found and reviewed 27 articles, and considered 2 for inclusion. In Scopus, we found and reviewed 6 articles, and considered zero for inclusion. In CINAHL, we found and reviewed one article, and considered zero for inclusion. In Cochrane Library, we found and reviewed zero articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the 2 articles considered for inclusion, zero randomized controlled trials and zero systematic studies met the inclusion criteria.*

## Diagnostic Facet Blocks (Intra-Articular and Nerve Blocks)

See Injection Therapies

## Myeloscopy

Endoscopic examination of the epidural space is termed “myeloscopy.” This procedure theoretically can be used solely for diagnostic purposes. It is most often performed in conjunction with adhesiolysis. The other method for performing adhesiolysis does not involve myeloscopy.(471-474)

*Recommendation: Myeloscopy for Diagnosing Acute, Subacute, or Chronic Cervical Pain, Thoracic Pain, Spinal Stenosis, Radicular Pain Syndromes, or Post-surgical Spine Pain*

**Myeloscopy is not recommended for diagnosing acute, subacute, or chronic cervical pain, spinal stenosis, radicular pain syndromes, or post-surgical back pain problems.**

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

*Level of Confidence – Low*

## Rationale for Recommendation

Currently, while there are studies suggesting different levels of neurological impingement are identified with myeloscopy, there are no quality controlled studies identifying the utility of this diagnostic procedure for improving long-term outcomes. A few reported studies have used this procedure in conjunction with adhesiolysis. Myeloscopy has not been shown to be beneficial in large scale, medium- to long-term studies sufficient.(472, 473) It is invasive, has likely complications, and is costly. Well-designed multi-center studies are needed prior to recommending this procedure.

## Evidence for the use of Myelography

There is 1 other study in Appendix 1.(474)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: myelography, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniated\*, displacement, displacements, displaced, disk, disc, discs, discs, pain, diagnostic, efficacy, efficiency, sensitivity, specificity, predictive value of tests, positive predictive value and negative predictive value. In PubMed we found and reviewed 2 articles, and considered 1 for inclusion. In Scopus, we found and reviewed 0 articles, and considered zero for inclusion. In CINAHL, we found and reviewed 0 articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed 0 articles, and considered zero for inclusion. We also considered for inclusion 1 article from other sources. Of the 2 articles considered for inclusion, zero randomized trials and zero systematic studies met the inclusion criteria.*

## Ultrasound (Diagnostic)

There are two uses for ultrasound technology – one is therapeutic (see Ultrasound (Therapeutic) in the heat therapies section), and the other is for diagnoses. Ultrasound projects high-frequency sound waves through tissue and records the echoes through a 2-dimensional imaging system. Ultrasound is seldom used for diagnostic purposes in the spine other than for unusual specific purposes such as detection and guided drainage of superficial abscesses.(475-481)

*Recommendation: Ultrasound for Diagnosing Cervical or Thoracic Pain*

**Diagnostic ultrasound is not recommended for diagnosing cervical or thoracic pain.**

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

*Level of Confidence – High*

## Rationale for Recommendation

Ultrasound has not been shown to result in improved patient outcomes or diagnoses other than minor applications. Ultrasound is not invasive, does not have adverse effects, and is moderately costly. There are other imaging techniques, which are currently shown to be useful for diagnosis in patients with spine pain. For most imaging purposes, CT and MRI are superior.

## Evidence for the Use of Ultrasound

There are no quality studies incorporated into this analysis.

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Neck, cervical, vertebral, vertebrae, spine, disc, discs, disks, disk, radiculopathy, radiculopathies, radicular, Efficacy, Efficiency, Diagnostic, diagnosis, pain, Cervicalgia, Neck pain, cervical pain, Radicular pain, Herniated disk, Cervical Radiculopathy, Postoperative neck pain, Postoperative cervical pain, Sensitivity, Specificity, Predictive Value of Tests, Positive predictive value, Negative predictive value, intervertebral disc, displacement, displacements, displaced, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 2540 articles, and considered 2 for inclusion. In Scopus, we found and reviewed 4 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 18 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 30 articles, and considered 0 for inclusion. We also considered for inclusion 3 articles from other sources. Of the 5 articles considered for inclusion, 0 randomized trials and 1 systematic studies met the inclusion criteria.*

## Thermography

Thermography is a diagnostic test that has been used to assess spine pain and radicular pain syndromes and other conditions.(482-484)

*Recommendation: Thermography for Diagnosing Acute, Subacute, or Spine Pain or Radicular Pain*

**Thermography is not recommended for diagnosing acute, subacute, or chronic spine pain, or radicular pain.**

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

*Level of Confidence – Moderate*

## Rationale for Recommendation

There are 2 moderate quality studies suggesting thermography is unhelpful for diagnostic purposes.(485, 486) Thermography is not invasive, has little potential for adverse effects, but is costly. Thus, there is no convincing evidence that thermography is an effective test for assessing spine pain.

## Evidence for the Use of Thermography

There are 2 moderate-quality incorporated into this analysis.(485, 486) There is 1 low-quality study in Appendix 1.(487)

*A comprehensive literature search was conducted using PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: neck, neck pain, cervical, radicular pain or radiculopathies, neck pain diagnosis, diagnostic, diagnosis, sensitivity, specificity, positive and negative predictive value, predictive value of tests, efficacy, efficiency; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, retrospective studies, or prospective studies. We found and reviewed 12 articles in PubMed, 44 in Scopus, zero in CINAHL, 10 in Cochrane Library and zero in other sources. We considered for inclusion 3 from PubMed, zero from Scopus, zero from CINAHL, and zero in other sources. Of the 3 articles considered for inclusion, 3 diagnostic studies and zero systematic studies met the inclusion criteria.*

## Fluoroscopy

Fluoroscopy is live (real-time) x-ray imaging which can define abnormalities that may be visualized on movement, but that are not apparent on static films. It has been used for evaluation of the cervical and thoracic spine.

*Recommendation: Fluoroscopy for Evaluating Acute, Subacute, or Chronic Cervical and Thoracic Pain*

**Fluoroscopy is not recommended for evaluating acute, subacute, or chronic cervical and thoracic pain.**

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

*Level of Confidence – Moderate*

## Rationale for Recommendation

The main use for fluoroscopy is to guide procedures (e.g., facet injections, radiofrequency procedures, etc.) that are discussed individually elsewhere. While this test for evaluating cervical and thoracic pain was previously used to image the spine, it has been largely supplanted by other studies. Because continual x-ray exposure is needed to obtain the images, exposure to radiation is far higher with this procedure than with static x-rays. Fluoroscopy is not invasive, has low risk of adverse effects, but is costly and involves considerable radiation exposure. There are no evidence-based indications for fluoroscopy outside of its use in the performance of specific diagnostic tests or procedures and other infrequent indications.

## Evidence for the Use of Fluoroscopy

There are no recent quality studies of the value of fluoroscopy in the evaluation of LBP or radicular pain syndromes or other back-related conditions.

*A comprehensive literature search was conducted using PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: neck, neck pain, cervical, radicular pain or radiculopathies, neck pain diagnosis, diagnostic, diagnosis, sensitivity, specificity, positive and negative predictive value, predictive value of tests, efficacy, efficiency; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, retrospective studies, or prospective studies. We found and reviewed 88 articles in PubMed, 4 in Scopus, 6 in CINAHL, 4 in Cochrane Library and 0 in other sources. We considered for inclusion 0 articles from PubMed, Scopus, CINAHL, Cochrane Library and from other sources.*

## Videofluoroscopy

Videofluoroscopy involves recording a videotape of fluoroscopic images of the spine that has been used for diagnostic purposes. Videofluoroscopy has been used for evaluation of the cervical and thoracic spine, particularly searching for possible spinal instability. After evidence interpreted as consistent with instability is found, surgery is typically proposed.

*Recommendation: Videofluoroscopy for the Assessment of Acute, Subacute, or Chronic Cervical and Thoracic Pain*

**Videofluoroscopy is not recommended for the assessment of acute, subacute, or cervical and thoracic pain.**

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



## Rationale for Recommendation

There are no studies demonstrating improved clinical outcomes attributable to videofluoroscopy. There are no validated criteria for the utilization of videofluoroscopy to evaluate spine conditions. Other diagnostic tests have been shown to be effective in the evaluation of these patients. Videofluoroscopy is not invasive, has little potential for adverse effects, but is costly. It involves considerable radiation exposure. The clinical relevance of instability demonstrated via videofluoroscopy has not been established.

## Evidence for Use of Videofluoroscopy

There are no quality studies regarding the use of videofluoroscopy.

*A comprehensive literature search was conducted using PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: neck, neck pain, cervical, radicular pain or radiculopathies, neck pain diagnosis, diagnostic, diagnosis, sensitivity, specificity, positive and negative predictive value, predictive value of tests, efficacy, efficiency; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, retrospective studies, or prospective studies. We found and reviewed 60 articles in PubMed, 159 in Scopus, 2 in CINAHL, 1 in Cochrane Library and 0 in other sources. We considered for inclusion 0 articles from PubMed, Scopus, CINAHL, Cochrane Library and from other sources.*

## Initial Care

### Education

In this guideline, “education” refers to formal, structured education programs separate from the education about diagnosis, treatment options, and prognosis that occurs at the time of office evaluation of the patient by a health care provider. Components of educational programs are quite variable and may include any or all of the following components: physical training, exercise, behavior modification, stress management, lifestyle change, education on anatomy, biomechanics, and “optimal posture.” (488-492) While the primary thrust of these programs is rehabilitation, a secondary aim used to justify the costs of this intervention is the prevention of subsequent musculoskeletal pain episodes.(493) A recent case series found adherence to exercise was more likely if there was greater self-efficacy, clarification of patients’ doubts by the provider, and supervision while the patient was learning the exercises.(494)

1. *Recommendation: Educational Programs for Select Patients with Subacute or Chronic Cervicothoracic Pain or Chronic Radicular Pain Syndromes*

**Educational programs are recommended for treatment of select patients with subacute or chronic cervicothoracic pain or radicular pain syndromes.**

Indications – Select patients with subacute or chronic cervicothoracic pain or radicular pain syndromes who require additional treatment and are motivated to adhere to the associated exercise components of the program on discharge.

Duration/Frequency – Two to 6 weeks(488, 489, 495) with re-evaluation of participation and symptomatology during that time. If a positive outcome, can be extended for an additional 4 to 6 weeks.(489, 493, 496) Frequency of contact up to 3 times a week.(497, 498)

Indications for Discontinuation – Resolution of symptoms, non-compliance with prescribed program, no improvement on follow up during initial implementation.

Benefits – Potential for improved adherence and faster recovery

Harms – Negligible. Possible reduced self-reliance.

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

Level of Confidence – **Moderate**

2. *Recommendation: Educational Programs for Acute Cervicothoracic Pain*

**Educational programs are not recommended as a sole treatment for acute cervicothoracic pain as other treatments are effective and it may be ineffective as a solitary treatment.**

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

3. *Recommendation: Educational Programs for the Prevention of Cervicothoracic Pain*

**There is no recommendation for or against the use of educational programs and education for prevention of cervicothoracic pain.**

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

## **Rationale for Recommendations**

There are quality studies that included educational programs. However, there are no trials that solely used an educational program, thus efficacy as a sole intervention is not demonstrated. An educational program has been used as the control group compared with another active intervention. Also, problematic is that trials do not describe these programs well. The advice/educational program groups often do not have all statistics performed on them for intragroup outcomes.(488, 496, 499, 500) This large programmatic variability also leads to difficulties in comparing the results between many of the RCTs. The more successful programs appear to have greater reliance on aerobic and endurance exercises and cognitive-behavioral principles than on education or flexibility exercises.(498)

A moderate-quality trial compared supervised exercises vs. advice alone in chronic whiplash associated disorder patients. The authors reported overall improvement in pain, functionality, and disability in both groups at the 12 month follow up. Employment status had greater improvement in the advice alone group than the supervised exercise group.(488) Another moderate-quality trial compared advice from a general practitioner to advice and exercise therapy as part of physiotherapy. At the 12-month follow-up, the advice-only group scored significantly better on work activities compared to patients treated by physiotherapists.(489) A moderate-quality trial evaluated the difference between general practitioner care and advice vs. manual therapy versus physiotherapy. The authors found greater benefits from manual therapy and physiotherapy for pain and recovery, but all groups had equal improvement at 12-month follow-up.(501) Another moderate-quality trial evaluating the difference between a supervised exercise program and an advice/home based exercise program reported better improvement in Self-Efficiency Scale, Tampa Scale, and Pain Disability Index at 3-month follow-up in the supervised group. Improvement in advice/home-based program was found as well, especially in the disability index score.(498)

There is evidence suggesting that educational programs may be associated with short-term improvements for chronic cervicothoracic pain and that such programs are more effective in a supervised setting than in a non-supervised setting.(488, 498) No quality evidence supports using educational programs for prevention as opposed to treatment.(13, 493) Even though there is little risk, there are no quality data to suggest a benefit of educational programs in preventing cervicothoracic pain.(493) Educational programs are not invasive, have low risk of adverse effects, but are expensive and consequently should be used in select patients who are likely to both achieve benefits and adhere to the program components after discharge.

## **Evidence for the Use of Education**

There is 1 high-(488) and 6 moderate-quality(490, 493, 496, 498, 500, 501) RCTs incorporated into this analysis. There is 1 low-quality RCT in Appendix 1.(502)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: cervicgia, neck pain, neck, cervical pain, cervical radiculopathy, radicular pain, herniated disk, postoperative neck pain, postoperative cervical pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 752 articles, and considered 2 for inclusion. In Scopus, we found and reviewed 54 articles, and considered 1 for inclusion. In CINAHL, we found and reviewed 0 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 1 articles, and considered 0 for inclusion. We included 0 articles from other sources. Of the 3 articles considered for inclusion, 1 randomized trial and 2 systematic studies met the inclusion criteria.*

## Fear Avoidance Belief Training

The Fear Avoidance Belief Model was developed in the 1980s to attempt to explain differences between patients who had resolution of acute cervicothoracic pain vs. those who progressed to chronic cervicothoracic or low back pain.(1518-1520) Waddell developed a questionnaire to investigate these fear avoidance beliefs in a clinical setting.(1521) Fear Avoidance Belief Training (FABT) was developed from a model to help individuals overcome fears that result in avoidance of activities and become self-fulfilling and self-reinforcing. Thus, FABT hopes to prevent the development of chronic cervicothoracic pain.(199, 1520, 1522-1524) Studies have been conducted to investigate the predictive ability of different measures, including clinical questionnaires, in the development of various measures of chronic cervicothoracic pain, including lost time and disability.(199, 1520, 1522) Interventions have involved specific training to directly address patient's fears, whether expressed or not, and address a de-emphasis on anatomical abnormalities, encouraging active management by the patient and education. FABT has been most frequently accomplished in the setting of physical rehabilitation programs, although it is not specific to any discipline. It is suggested that all health care providers be familiar with these principles and frequently remind patients of the main teaching points in these principles in the course of treatments for cervicothoracic pain.

*Recommendation: Fear Avoidance Belief Training for Acute, Subacute, or Chronic Cervicothoracic Pain*

**FABT is recommended for acute, subacute, or chronic cervicothoracic pain, particularly if there are any suggestions of fear avoidance belief issues.**

*Indications* – Acute, subacute, or chronic cervicothoracic pain.

*Frequency/Duration* – The most important intervention may be that all health care providers be aware of these principles and intervene with appropriate training and education at the first appointment. A typical program consists of 2 to 3 appointments for a total of approximately 6 appointments for acute and subacute cervicothoracic pain. Patients with more severe or chronic cervicothoracic pain problems may require up to 12 appointments. This training is most commonly accomplished in the context of physiotherapy physical therapy appointments.

*Indications for Discontinuation* – Resolution of fear avoidance beliefs or failure to respond.

*Harms* – None reported.

*Benefits* – Improved exercise compliance and earlier functional restoration

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

*Level of Confidence* – **Moderate**

## Rationale for Recommendation

There are no randomized trials evaluating FABT as an independent intervention. There are cohort studies evaluating fear-avoidance behavior and the impact it has on chronicity of cervicothoracic pain.(1520, 1522) There are multiple trials in cervicothoracic pain that include FABT as a component of an intervention or have an “act as usual group” with a poor explanation of the advice given.(199, 489, 496, 498, 508) The data suggest that FABT is beneficial and should be started during the first visit for acute cervicothoracic pain.(508, 1520, 1522)

FABT has been evaluated in acute, subacute, and chronic low back pain patients with quality studies.(1525) All of these studies demonstrated that those with elevated fear avoidance beliefs (FABs) benefited from the intervention (1526-1528) with one exception – that exception was in Norway among individuals on disability pensions, thus applicability to the U.S. or to acute, subacute, or even chronic cervicothoracic pain settings seems remote (1529) (see Low Back Disorders guideline).

FABT is moderate cost as a sole intervention, but low cost for educational information in addition to other provider visits. Thus, FABT is recommended for acute, subacute, or chronic cervicothoracic pain patients with elevated FABs at baseline with or without referred pain.

## Evidence for the Use of FABT

There are 2 high-(489, 508) and 6 moderate-quality(199, 496, 498, 1523, 1524, 1530) RCTs incorporated into this analysis. There is 1 low-quality RCT in Appendix 1.(1531)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Fear Avoidance Belief Training, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial,*

controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 961 articles, and considered zero for inclusion. In Scopus, we found and reviewed 42 articles, and considered 2 for inclusion. In CINAHL, we found and reviewed zero articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed zero articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the 11 articles considered for inclusion, 11 randomized trials and zero systematic studies met the inclusion criteria.

## Activity Modification and Exercise

### Rest And Relative Rest

Rest and relative rest have long been used for the treatment of cervical pain, particularly acute cervical pain.(503) Use of rest is believed to have evolved from consideration of increased pain on a short-term basis experienced during activity by those with cervical pain, without consideration of whether there might be adverse short or longer-term implications. Prescriptions of rest have also implied that compliant patients were those that spent a greater proportion of time resting their neck and wearing cervical collars to presumably recover sooner. Rest is often prescribed in the form of wearing a cervical collar.

#### 1. Recommendation: Rest and Immobilization for Acute Cervicothoracic Pain

**Rest and immobilization are moderately not recommended for the management of acute cervicothoracic pain.**

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

Level of Confidence – **High**

### Rationale for Recommendation

Quality studies have been reported with many studies having shown that maintaining activity and active forms of treatment are superior to neck immobilization and rest in the first 14 days after neck injury.(504-508) A higher quality study found that the patients randomized to wearing a neck collar had poorer outcomes in working ability and disability compared to active groups at 12 months.(508) Though rest is non-invasive, it is costly and associated with high morbidity, and therefore not recommended.

#### 2. Recommendation: Rest for Subacute and Chronic Cervicothoracic Pain

**Rest is not recommended for the management of subacute and chronic cervicothoracic pain as it is suspected to be as ineffective for these situations as it is for acute cervicothoracic pain.(498)**

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

Level of Confidence – **High**

#### 3. Recommendation: Rest for Radicular Pain Syndromes

**Rest is not recommended for the management of radicular pain syndromes.**

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

Level of Confidence – **High**

### Rationale for Recommendations

Multiple quality trials showed increasing, rather than decreasing activity was associated with improvement in neck and cervicothoracic pain.(509) Early mobilization was shown to be more effective than rest in acute cervical pain and interventions with exercises resulted in marked improvement over controls or less active interventions.(509-511) A study comparing anterior fusion surgery, physical therapy with multiple treating clinicians and a lack of standardized treatment, and 3 months of cervical collar in patients with cervical radiculopathy referred for surgery showed that the cervical collar group was the slowest to recover, but at 12 months all three groups had similar recoveries.(512)

It is suspected that rest is as unhelpful as it is for lumbar radiculopathy (see Low Back Disorders guideline). A recent study comparing semi rigid neck collar, physiotherapy, and usual activity in patients with cervical radiculopathy found that patients in either the neck collar or physiotherapy groups did equally well at 6 weeks and 6 months.(342)

Cervicothoracic braces, while non-invasive and generally low cost are not recommended. Bed rest, while not studied in cervicothoracic pain, is costly primarily due to lost time, and can have documented adverse effects beyond those associated with deconditioning, such as pulmonary emboli.(513) Studies document that compliance is poor, which likely results in underestimation of the magnitude of the adverse effects of this intervention. Bed rest is strongly not recommended as a treatment strategy for management of acute cervicothoracic pain. However, bed rest for unstable fractures is recommended.

## Evidence for the Use of Rest and Relative Rest

There is 1 high-(508) and 5 moderate-quality(342, 504, 510-512) RCTs incorporated into this analysis. There are 3 low-quality(505-507) RCTs in Appendix 1.

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: rest, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed, we found and reviewed 14 articles, and considered zero for inclusion. In Scopus, we found and reviewed 279 articles, and considered zero for inclusion. In CINAHL, we found and reviewed 19 articles, and considered two for inclusion. In Cochrane Library, we found and reviewed 14 articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the 6 articles considered for inclusion, zero randomized trials and zero systematic studies met the inclusion criteria.*

## Sleep Pillows And Sleep Posture

Pillows and certain sleep postures are believed by some to be superior. The controversy appears largely driven by two different issues. One is a theory that a straight spine while sleeping is beneficial and the second is commercial. This theory holds that specific sleep postures that maintain the nocturnal alignment of the spine will reduce cervical pain incidence, persistence, and/or severity. Recommendations include sleeping on the side, sleeping with a pillow specifically designed for patients with cervical pain, and use of brand-name pillows and mattresses.(514-516)

### 1. Recommendation: Sleep Posture for Acute, Subacute, or Chronic Cervicothoracic Pain

**The sleep posture most comfortable for the patient is recommended for treatment of acute, subacute, or chronic cervicothoracic pain. If a patient habitually chooses a particular sleep posture, it may be reasonable to recommend altering posture to determine if there is a reduction in pain or other symptoms.**

*Indications* – Acute, subacute, or chronic cervicothoracic pain that results in nocturnal awakening, particularly if not amenable to other treatments.

*Indications for Discontinuation* – Non-tolerance.

*Harms* – Negligible.

*Benefits* – Better sleep and potentially reduced pain.

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

*Level of Confidence* – **Low**

### 2. Recommendation: Neck Pillows for Acute, Subacute, or Chronic Cervicothoracic Pain

**There is no recommendation for or against the use of specific commercial products (e.g., neck pillows) as there is no quality evidence that they have roles in primary prevention or treatment of acute, subacute, or chronic cervicothoracic pain.**

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

*Level of Confidence* – **Low**

## Rationale for Recommendations

Changing sleep posture is low cost and not invasive, although there is the potential for increased symptoms. Most of the studies done on neck pillows are lower quality; very few are RCTs. One moderate quality RCT suggested some differences between types of pillows that would need further investigation prior to a recommendation. (Gordon 10) No long-term studies have been reported.(517) A study evaluated neck pillows as part of a rehabilitation program where exercise seemed to be the

main component with benefit, but the neck pillow may have had some role in the outcomes, although the trial is confounded by multiple co-interventions.(518) There are two non-randomized trials(512, 519) in patients that trended toward benefit of neck support while sleeping. Another study(520) suggested some improvement with use of any neck pillow. Among those who had 4 weeks of inpatient rehabilitation with one group receiving a neck pillow, follow-up in 12 months showed overall better maintenance of improvement among those who received the pillow in the hospital.(521) There has not been a cost analysis done to show the true cost of the pillow for the improvement seen in some studies.

## Evidence for the Use of Sleep Pillows and Sleep Posture

There are 3 moderate-quality RCTs incorporated into this analysis.(515, 518, 521) There are 2 low-quality(520, 522) crossover trial or RCT in Appendix 1.

*Sleep Pillows and Sleep Posture - A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: bedding and linens, sleep posture, neck pillows, sleep pillows, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed, we found and reviewed 12 articles, and considered 3 for inclusion. In Scopus, we found and reviewed 19 articles, and considered two for inclusion. In CINAHL, we found and reviewed one articles, and considered one for inclusion. In Cochrane Library, we found and reviewed zero articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the 5 articles considered for inclusion, one randomized trial and two systematic studies met the inclusion criteria.*

## Mattresses

Mattresses of all types have been used according to personal preference and there are strong advocates particularly regarding therapeutic value of firm mattresses.

### 1. Recommendation: Mattresses for Treatment of Acute, Subacute or Chronic Cervical and Thoracic Pain

**There is no recommendation for or against the use of mattresses for treatment of acute, subacute, or chronic cervical or thoracic pain other than to raise provider awareness that the dogma to order patients to sleep on firm mattresses appears wrong regarding the lumbar spine. By analogy, sleeping on the floor may be incorrect as well.**

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

*Level of Confidence – Low*

### 2. Recommendation: Other Sleeping Surfaces for Treatment of Acute, Subacute, or Chronic Cervical and Thoracic Pain

**There is no recommendation for or against the use of optimal sleeping surfaces (e.g., bedding, water beds, and hammocks) for treatment of acute, subacute, or chronic cervical and thoracic pain. It is recommended that patients select mattresses, pillows, bedding, or other sleeping options that are most comfortable for them.** Individuals with spine pain may report better or worse pain and associated sleep quality with different sleeping surfaces. In cases where there is pain sufficient to interfere with sleep, recommendations by the provider for the patient to explore the effect of different surfaces in the home is appropriate. This could include switching to a different mattress, sleeping on the floor with adequate padding, and use of a recliner. Any recommendation in this regard should be preceded by adequate exploration of varied sleep positions/posture that could improve sleep quality.

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

*Level of Confidence – Low*

## Rationale for Recommendations

There are no quality studies in cervical spine patients. One quality study of chronic LBP patients reported a medium firm mattress was superior to a firm mattress,(523) but it neither discussed sleep position nor prior mattress firmness which may be important issues. Another trial suggested a waterbed or foam mattress is superior to a hard mattress.(524) Mattress selection is subjective and depends on many factors including personal habits and the weight/size of an individual. For these reasons, individuals must evaluate which mattress is best suited to provide some relief to their particular problem and it is

not appropriate for providers to order mattresses or bedding for patients. However, providers should be aware that the dogma that a more firm mattress is superior to a less firm mattress currently appears wrong.

## **Evidence for the Use of Mattresses**

There are no quality studies incorporated into this analysis.

## **Exercises**

Exercises have long been considered among the most important therapeutic options for the treatment and rehabilitation of musculoskeletal disorders including cervical and thoracic pain.(525-527) Research has shown that aerobic exercises can reduce pain for up to 30 minutes after exercise.(528) However, despite a plethora of literature, the vast numbers of possible permutations and combinations of exercises impairs the ability to identify specific exercises that demonstrate particular benefit, particularly as trials nearly always include various combinations of exercises and are frequently unstructured.(488, 496, 501, 506, 529-532)

Similar to low back pain, the spectrum of patients with neck pain makes up a heterogeneous population with many different variables contributing to an individual patient's presentation. There is some preliminary evidence that patients with differing clinical presentations of cervical pain do not benefit equally from all types of therapeutics.(493, 529, 533, 534) The resulting theory is that some patients with specific disorders or presentations are more likely to benefit from different types of exercise programs.(13, 19, 488, 493, 499, 529, 533, 535-544) These classification systems, while suggesting possible improved outcomes from treatment based on syndromes (e.g., mobility, centralization, exercise and conditioning, pain control and headache),(19) await full validation studies.

There are many different types of exercise that have been assessed in many different settings with heterogeneous populations of patients. Outcome measures used are similarly heterogeneous (e.g., pain, composite scores such as the Neck Disability Index (NDI), modified duty, lost time, or disability ratings). There are an increasing numbers of studies suggesting longer-term benefits from exercise programs beyond 4 to 6 months.(499, 527, 529, 535, 536, 545-552)

Many studies have also combined exercise with manual therapy and some evidence suggests superior outcomes with that approach.(499, 533, 537, 553-555) A study created an algorithm for individualizing a therapy program compared to no intervention and reported better outcomes with the individualized therapy.(533)

There are few studies evaluating exercise as an intervention to prevent cervicothoracic pain. One study reported strength resistance training and overall increased physical activity helped prevent the development of cervicothoracic and shoulder pain over a 1-year period.(493)

There are also different programs with varied sequences and combinations of exercises. Taken in composite, the evidence of a beneficial effect of exercise for the treatment of cervicothoracic pain is moderately strong, but individually the evidence for any one exercise is weaker. Exercises can be segregated into different categories, but for purposes of this discussion, these three broad categories or "domains" of exercise will be utilized: aerobic, stretching/flexibility/centralizing, and strengthening/stabilization.

One major issue is motivation to exercise. Most RCTs evaluating exercise programs have supervised sessions where participants are accountable for doing the exercises or are able to do the exercises as part of a paid working day,(488, 498, 556) and also often keep exercise journals. One study did not inform participants of a planned 36 month follow-up and found that 17 to 25% of participants reported they were still complying with the exercise program and 35 to 40% were performing no exercises.(552)

Yet, formal supervision is not always necessary while performing exercises. Scholten-Peeters suggested even general practitioner care with advice on graded activity can be as beneficial as formal treatment with a physical therapist where the focus is education, graded activity and exercise.(489)

## **General Exercise Approaches and Recommendations**

Exercise is commonly recommended as a prescription for a healthy lifestyle. Specific exercise regimens are often used as treatments for acute, subacute, and chronic cervicothoracic pain. An exercise prescription should address specific treatment goals and be time limited with transition to an independent exercise program as part of a healthy lifestyle. The purposes of

supervised exercise therapy are symptom reduction, functional improvement, and educating the patient so that he or she can independently manage the program. Evaluation of an exercise prescription involves consideration of five critical components:

1. Stage of (theoretical) tissue healing (acute, subacute, chronic);
2. Severity of symptoms (mild, moderate, severe);
3. Degree and type of deconditioning (flexibility, strength, aerobic, muscular endurance);
4. Centralization pain response; and
5. Psychosocial factors (e.g., medication dependence, fear-avoidance, secondary gain, mood disorders).(549) (Vonk 09)

### ***General Exercise Approach: Acute Cervicothoracic Pain***

Stretching, aerobic, and directional centralizing exercises are recommended. Pain control modalities may be needed as a complement to exercise. Classification-based exercise management may be beneficial in selection of specific exercises.(506, 510) The recommended frequency is 1 to 3 sessions a week for up to 4 weeks as long as objective functional improvement and symptom reduction is occurring.(557)

### ***General Exercise Approach: Subacute Cervicothoracic Pain***

For patients with no prior treatment, the treatment plan is similar to acute cervicothoracic pain. For those who failed acute treatment, a trial of more intensive reconditioning that includes strengthening exercises is recommended. Particular attention should be paid to psychosocial factors that may impair compliance with exercise recommendations among those with subacute cervicothoracic pain, as it is believed that it is possible to reduce the risk of cervicothoracic pain becoming chronic. The frequency is 2 to 3 sessions a week for 4 weeks, as long as there is objective functional improvement, symptom reduction, patient compliance, and efficacy. Progress should be reassessed after 6 to 8 sessions. Visit frequency depends on work status, symptom severity, comorbidities, and functional status.(488, 498) As the participants learn the exercises it may be reasonable to move from individualized therapy sessions to group session of 3 to 4 patients.(498)

### ***General Exercise Approach: Post-operative Exercising***

Post-operative progressive exercise programs should first emphasize flexibility and aerobic exercises and then progress to strengthening. Treatment frequency of 1 to 3 sessions a week progressing to 2 to 4 sessions a week is recommended depending on patient compliance, objective functional improvement, and symptom reduction. Reassessment should occur after 6 to 8 sessions with continuation based on demonstration of functional improvement. The upper range is 12 sessions.

### ***General Exercise Approach: Chronic Episodic Cervicothoracic Pain and Radicular Pain***

For patients with mild symptoms or a flare-up of symptoms, the treatment focus is on education regarding home management and exercise. Individuals with mild symptoms and minimal functional limitations may receive a therapy evaluation and one follow-up visit to adjust the home therapy program. For individuals with a moderate to severe flare-up with mild to severe disability, treatment should consist of a progressive exercise program first emphasizing strength and endurance exercises with treatment frequency of 1 to 3 visits a week up to a maximum of 8 to 12 visits.(558) Reassessment should occur after visit 6, with continuation based on patient compliance, objective functional improvement, and symptom reduction.

### ***General Exercise Approach: Chronic Cervicothoracic Pain and Radicular Pain***

For patients with mild symptoms and minimal disability, treatment should consist of a therapy evaluation to instruct the patient in a home-based exercise program, with 1 to 2 follow-up visits. For patients whose prior treatment failed and who have moderate symptoms and some functional deficits but no previous exposure to exercise therapy, treatment would be the same as for a patient with subacute symptoms (outlined above). If the patient failed prior exercise therapy, consider 6 additional exercise visits, or consider an interdisciplinary approach (see Chronic Pain guideline for managing patients with severe chronic pain or disability). It is recommended patients exercise 3 to 5 times a week.(493, 559)

### ***General Exercise Approach: Cervicothoracic Pain Prevention***

Some studies have attempted to determine whether exercise may prevent neck pain.(560, 561) A detailed, evidence-based and validated exercise prescription for this purpose is not yet possible.



## Evidence for the Use of Other Exercises

There are 2 high-(489, 562) and 37 moderate-quality (one with two reports)(342, 490, 493, 498-501, 518, 536, 547, 549, 550, 556, 557, 559, 563-585) RCTs incorporated into this analysis. There are 12 low-quality RCTs and 2 other studies in Appendix 1.(576, 586-598)

## Aerobic Exercises

Theoretical benefits of aerobic exercise include improved aerobic capacity, improved blood flow, less depression, and higher pain thresholds and pain tolerance. These exercises include walking, running, bicycling, and many other activities. Whether there is benefit from weight-bearing vs. non-weight bearing aerobic exercises remains unclear. However, an exercise test is not believed to be necessary for the evaluation and treatment of the vast majority of cervicothoracic pain patients. For most patients, a structured, progressive walking program on level ground or no incline on a treadmill is recommended. For patients who desire aerobic exercises, there are no specific data, although there are indications that imply that there is a direct correlation between benefit and the amount of aerobic activity that results in higher MET expenditure. Therefore, the activity that the patient will adhere to is believed to be the one most likely to be effective, given that compliance is a recognized problem. Similar to other exercises, there is gathering evidence suggesting specific exercises may be helpful for specific presentations although those data have not yet been fully validated.(599)

### 1. Recommendation: Aerobic Exercises for Acute, Subacute, or Chronic Cervicothoracic Pain

**Aerobic exercise is recommended for treatment of acute, subacute, or chronic cervicothoracic pain.**

*Indications* – All patients with acute, subacute, and chronic cervicothoracic pain are believed to benefit from aerobic exercises, especially those with whiplash-associated injury.(338, 557) Those with significant cardiac disease, or significant potential for cardiovascular disease should be evaluated prior to institution of vigorous exercises. It is recommended that the American College of Sports Medicine’s *Guidelines for Exercise Testing and Prescription, 9th ed.*,(600) be followed for health screening and risk stratification.

*Frequency/Duration* – For patients with chronic cervicothoracic pain, there is no quantified prescription available, however, based on analogy to the quality evidence for treatment of LBP, walking at least 4 times a week at 60% of predicted maximum heart rate is recommended. For acute or subacute cervicothoracic pain patients, a graded exercise program is generally desired, often using distance or time as minimum benchmarks – e.g., start with 10 to 15 minutes twice a week(498) for 1 to 2 weeks and increase in 10 to 15 minute increments per week until at least 30 minutes walking a day is achieved. Studies that included exercises less frequently did not show any benefit.(601) However, vigorous exercise is generally not indicated until after a solid fusion has been accomplished.

*Indications for Discontinuation* – Aerobic exercise should be adjusted, reduced, or discontinued when there is intolerance (rarely occurs) or development of other disorders. Nearly all patients should be encouraged to maintain aerobic exercises on a long-term basis for both prevention of cervicothoracic pain and to maintain optimal health.

*Benefits* – Improvement in spine pain, improved cardiovascular fitness.

*Harms* – None reported in quality studies. Increased pain with onset of exercise. Theoretical risk of myocardial infarction and angina in a severely deconditioned patient.

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

*Level of Confidence* – **Moderate**

### 2. Recommendation: Aerobic Exercises for Acute Post-operative Cervical Pain

**Aerobic exercise is recommended for acute post-operative cervicothoracic rehabilitation of patients.**

*Benefits* – Improvement in spine pain, improved cardiovascular fitness.

*Harms* – None reported in quality studies. Increased pain with onset of exercise. Theoretical risk of myocardial infarction and angina in a severely deconditioned patient.

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

*Level of Confidence* – **Moderate**

## Rationale for Recommendations

While many studies included some aerobic exercises(488, 493, 538, 545) as part of a battery of exercises, there are no quality RCTs that solely or largely evaluated aerobic exercise as an intervention in any group. The studies that included aerobic exercises did report benefits; however, due to the scarcity of details on types of aerobic exercises or a tendency for the aerobic exercises to be a part of the intervention or also be included in the control group’s treatment,(548) there is less data

on the benefit of aerobic exercises in cervicothoracic pain compared to low back pain. In addition, there is no quality evidence for post-operative cervicothoracic rehabilitation. A study evaluating bicycling showed a decrease in pain up to 2 hours after the therapy sessions, but the decrease in pain was not long lasting.(602)

## Evidence for the Use of Aerobic Exercise

There is 1 high-(488) and 24 moderate-quality(490, 493, 498, 510, 535, 539, 541, 545, 548, 599, 601, 603-614) RCTs incorporated into this analysis. There are 5 low-quality studies in Appendix 1.(615-619)

## Directional Exercise

Directional exercise has been used for treatment of cervical pain.(76, 620)

*Recommendation: Directional Exercises for Treatment of Acute, Subacute, Chronic, or Radicular Cervical and Thoracic Pain*

**Directional exercises are recommended for patients found to have directional preference (i.e., centralization or abolishment of pain in a direction).**(621) This has been described in the lumbar spine and adapted to the rest of the spine including the cervical spine.(620) For chronic pain, directional exercises are generally not the primary or sole exercise treatment as aerobic and strength deficits are usually present.

*Indications – For acute, subacute, or chronic cervical and thoracic pain, directional preference exercises are recommended. Frequency/Duration – Exercise frequency is determined by the stage of recovery. They are initially performed every two hours (8-10 repetitions) to fully centralize and abolish the pain, along with posture modifications that also honor patients’ directional preference and protect the patient from symptoms returning when not exercising. Once the pain is eliminated even for a short period of time, the same exercises and posture changes should continue proactively to attempt to prevent the pain from returning. Proactive exercise remains important in maintaining a pain-free status as the opposite direction of spinal movement and positioning are progressively re-introduced. The duration of this sequence is typically a few days or weeks. Indications for Discontinuation – Directional exercises should be discontinued if there is worsening pain in the course of treatment or failure to improve.*

*Benefits – Often rapid elimination of the pain and earlier return to function.*

*Harms – Similar to all therapies, risk of increased pain.*

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

*Level of Confidence – Moderate*

## Rationale for Recommendations

There are no quality studies of directional exercise for treatment of the cervical spine. There is one low quality study in chronic cervical pain patients suggesting efficacy.(620) There is evidence of efficacy for using directional exercise to treat the lumbar spine and thus, directional exercise is recommended for treatment of the cervical spine.

## Evidence for the Use of Directional Exercise

There is 1 low-quality RCT in the Appendix.(620)

## Stretching And Flexibility

Stretching exercises include active movements to improve joint mobility and centralize symptoms, and to increase the length of a target muscle group.(622) Stretching exercises also have been utilized for both treatment as well as prevention, and are used in some manufacturing settings as part of an injury prevention program. Generally, most stretching exercises are actively performed by a patient. However, it is also possible to perform such exercises passively or with assistance of a provider. The latter should be performed carefully to not exceed the patient’s natural range of motion and incur an injury.

1. *Recommendation: Stretching for Acute or Subacute Cervicothoracic Pain*

**Specific stretching exercises are recommended for treatment of acute or subacute non-specific cervicothoracic pain.**

*Indications – Acute or subacute cervicothoracic pain under the direction of health care professional.*

*Frequency/Duration – For pain that centralizes during an exam using repeated end-range test movements, single directional end-range exercises are believed to be preferred (see Directional Exercise).(70)*

Three to 5 times a day for acute cervicothoracic pain; 2 to 3 times a day for subacute or chronic cervicothoracic pain. Stretching exercises shown to be beneficial include extension, flexion, and rotation held for 30 seconds, repeated 3 times daily, 5 times a week.(536)

*Indications for Discontinuation – Increased pain during course of treatment; failure to improve.*

*Benefits – Shorter recovery time.*

*Harms – Increased pain especially short term, and particularly if stretch in a direction of worsening (see Directional Exercise). Theoretical risk of muscle strain from over-stretching.*

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

*Level of Confidence – Moderate*

2. *Recommendation: Stretching for Chronic Cervicothoracic Pain*

**Stretching is recommended for treatment of chronic cervicothoracic pain.**

*Benefits – Shorter Recovery Time*

*Harms – Increased pain especially short term, and particularly if stretch in a direction of worsening (see Directional Exercise). Theoretical risk of muscle strain from over-stretching.*

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

*Level of Confidence – Moderate*

3. *Recommendation: Stretching for Prevention of Cervicothoracic Pain*

**There is no recommendation for or against stretching exercises as an isolated prescription or program for purposes of preventing cervicothoracic pain.**

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

*Level of Confidence – Low*

## Rationale for Recommendations

There is quality evidence suggesting that stretching exercises may be of assistance particularly in those with subacute or chronic cervicothoracic pain.(536, 545, 559, 623) Stretching exercises shown to be beneficial include extension, flexion, and rotation held for 30 seconds, repeated 3 times daily, five times a week.(536) Studies report that stretching programs decreased pain and disability in chronic non-specific cervicothoracic pain over their baseline up to 12 months.(499, 536, 538, 557, 623, 624) Follow-up 3 years later in one cohort showed they maintained the improvement over baseline,(552) however; the stretching only control group was not included in the 36 month follow up. Other shorter term studies evaluated stretching as an intervention group and report mixed results.(625) Many other RCTs used stretching as a control group activity and did not find much benefit over baseline measures.(626) As with many other RCTs evaluating exercise and cervicothoracic pain, stretching is often a component of a mixed exercise intervention program.(498, 538, 545, 559, 627, 628) A study evaluated relaxation and stretching compared to dynamic exercises and found no significant improvement over baseline; however, compliance was low.(629)

There are concerns that over-stretching may result in additional injuries to patients. Aggressive stretching requires a health care provider for each session and thus costs are considerably greater than those for self-performed stretching exercises. While these treatments are not invasive, there are concerns that the potential for harm outweighs the potential for benefit. There are many other interventions with evidence of efficacy. Stretching exercises actively performed by patients for purposes of treatment and rehabilitation of cervicothoracic pain are low cost when performed as a home exercise program, are not invasive, and have low potential for adverse effects. They may help alleviate the stiffness that occurs with cervicothoracic pain that is thought to contribute to increased pain. These exercises are recommended.

## Evidence for the Use of Stretching and Flexibility

There are 12 moderate-quality RCTs incorporated into this analysis.(497, 498, 545, 557, 559, 604, 627, 629-633) There are 6 low-quality(622-624, 634-636) RCTs and 1 other study in Appendix 1.(637)

## Strengthening and Stabilization Exercises

Strengthening exercises theoretically may be used for purposes of improving or regaining prior maximum strength. Such improved strength would result in the ability to perform the same task at a lower percentage of maximum voluntary contraction, which in theory improves the individual's margin of safety.(638, 639) However, quality evidence to support the theory is sparse.(293, 488, 599, 608, 610, 611, 614, 640-642) A caution is that in the process of strengthening, sustaining a

strain is possible. Another issue is that long-term compliance is required and is difficult to achieve. Fear avoidance belief training appears important in the management of patients with cervicothoracic pain (see Fear Avoidance Belief Training link under Rehabilitation for Delayed Recovery).(489, 496, 498) Inclusion of these principles in the course of exercise training or supervision appears to be beneficial. This would also strengthen the education of the patient about cervicothoracic pain and if there is a team treating the patient, all team members should have the same advice about exercise.

1. **Recommendation: Strengthening and Stabilization Exercises for Acute, Subacute, or Chronic Cervicothoracic Pain**  
**Strengthening, endurance, and aerobic exercises are moderately recommended for treatment of acute, subacute, or chronic cervicothoracic pain.**

*Indications* – Acute, subacute, or chronic cervicothoracic pain.

*Frequency/Duration* – Home program frequency is 3 to 5 times a week for subacute or chronic cervicothoracic pain.(7, 493, 541, 556, 558, 599, 643) Supervised treatment frequency and duration is dependent of symptom severity and acuity and the presence of comorbid conditions. Studies that had lower weekly participation in exercise programs failed to find benefits compared to controls.(629) Improvement of symptoms overall may be somewhat independent of exact exercise program type.(529, 541, 599, 606, 607) It appears in the literature that exercise programs that include both aerobic and strengthening often have better success in long-term compliance.(536, 547, 558) It is recommended that a program for strengthening include aerobic exercises as well.

*Indications for Discontinuation* – Resolution, failure to improve, noncompliance; development of injury in the course of exercise generally requires short-term reductions in exercise prescriptions.

*Benefits* – *Improvement in spine pain, improved strength and fitness.*

*Harms* – *Increased pain, especially short-term. Theoretical risk of musculoskeletal injury.*

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

*Level of Confidence* – **High**

2. **Recommendation: Fear Avoidance Belief Training**  
**Inclusion of fear avoidance belief training during the course of rehabilitation is recommended.**

*Benefits* – *Improvement in exercise and activity compliance, with resultant improved LBP, improved fitness.*

*Harms* – *None reported.*

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

*Level of Confidence* – **High**

## Rationale for Recommendations

Many quality trials have evaluated strengthening exercises for chronic cervicothoracic pain,(7, 488, 489, 493, 499, 529, 535-537, 540, 541, 545-547, 549, 556, 558, 559, 607, 625, 629, 644-647) however, these exercises are often part of a program that includes strengthening, stretching, and some aerobic exercises. The longer the exercise program, the longer lasting the outcomes appear to be.(529, 536, 559, 646) The more dynamic the program the more improvement reported compared with very low intensity exercises.(493, 552, 559) It has also been shown that the greater the pain reported by the patient and greater the disability the more robust the benefits are of strengthening programs.(489, 535) More intense exercises regimens that include both concentric and eccentric muscle contraction with high intensity (8 to 12 lifts) and high volume (9 sets per session) have shown to have greater effect.(493, 535, 541, 607)

Studies that included fear avoidance belief training in their design showed that the intervention group had better outcomes.(489, 496, 498) These studies were not designed to specifically evaluate fear avoidance or behavioral support, but included them in their study protocols for the intervention groups.

## Evidence for the Use of Strengthening and Stabilization Exercise

There are 1 high-(489) and 36 moderate-quality(7, 493, 496, 498, 499, 529, 536, 537, 541, 545-547, 549, 552, 556, 558, 604, 606-608, 610, 611, 614, 625, 629, 631, 640-642, 644, 645, 647-651) RCTs incorporated into this analysis. There are 11 low-quality(506, 615-617, 636, 646, 652-656) RCTs and 3 other studies(293, 637, 657) in Appendix 1.

## Aquatic Therapy (Including Swimming)

There are no quality studies evaluating aquatic therapy in patients with cervical pain of any duration. Aquatic therapy involves the performance of aerobic, and/or flexibility, and/or strengthening exercises in a pool to minimize the effects of

gravity, particularly where reduced weight-bearing status is desirable. However, this is less applicable with cervical pain patients than back or lower extremity pain patients.

*Recommendation: Aquatic Therapy (Includes Swimming) for Acute, Subacute, or Chronic Cervicothoracic Pain*

**There is no recommendation for or against the use of aquatic therapy for acute, subacute, or chronic cervicothoracic pain.**

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

*Level of Confidence – Low*

## Rationale for Recommendation

There are no quality trials evaluating aquatic therapy exercises in cervicothoracic pain patients. Practitioners are cautioned that, unlike with low back pain patients, swimming may lead individuals to use prolonged awkward neck positions during the activity that may exacerbate cervical pain symptoms. Other therapies have been shown to be efficacious.

## Evidence for the Use of Aquatic Therapy

There are no quality studies incorporated into this analysis.

## Yoga

Yoga for purposes of treating cervicothoracic pain has not been reported in quality trials.(630, 658, 659) Yoga involves postures, stretches, breath control, and relaxation. There are many different types of yoga that are practiced. In the cervical literature a variation of yoga called Qigong, has been evaluated. This review focuses on the exercise aspects of yoga and does not endorse or support spiritual elements or specific religious beliefs.

*Recommendation: Yoga for Acute, Subacute, or Chronic Cervicothoracic Pain*

**There is no recommendation for or against yoga for acute, subacute, or chronic cervicothoracic pain.**

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

*Level of Confidence – Low*

## Rationale for Recommendation

Moderate-quality RCTs that evaluated Qigong with other exercises found no significant difference although both groups improved.(546, 647) Since yoga has low or no risk, and may encourage exercise and activity, it may be an option for motivate patients with chronic cervicothoracic pain.

## Evidence for the Use of Yoga

There are 5 moderate-quality RCTs incorporated into this analysis.(546, 630, 647, 659, 660) There are 4 low-quality RCTs in Appendix 1.(661-664)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: stair climbing, elliptical training, indoor rower, stairmaster, stationary bicycle, treadmill, jogging, walking, cycling, running, cross country skiing, cross country running, Nordic walking, inline skating, rowing, kick boxing, skipping rope, jump rope, circuit training, jumping jacks, 5BX, XBX, aerobic exercise, aerobics, aerobic exercises, exercise, cardio exercise, cardio exercises, aerobic programs, aerobics programs, aerobic exercise therapy, endurance training, tolerance training, exercise tolerance, strengthening exercise, weight lifting, weight bearing, lifting, stretching, muscle stretching, stretching exercises, stretching exercise, muscle stretching exercise, stretch, flexibility, passive stretching, static stretching, relaxed, isometric, static active stretching, specific stretching, PNF, cervical stabilization exercises, stabilization, postural exercises, neck stabilization, neck stabilization, specific neck stabilization, stabilization training, active neck stabilization, aquatic therapy, pool therapy, swimming, aqua therapy, hydrotherapy, Ai Chi, Aqua running, Bad Ragaz Ring Method, watsu, deep water exercise, shallow water exercise, yoga, hatha yoga, qigong, breath control, relaxation, relaxation control, therapeutic exercise, warm-up exercise, exercise intensity, abdominal exercises, pilates, walking, plyometrics, home maintenance, physical fitness, sports, yoga pose, athletic training, exercise positions, isokinetic, isometric and isotonic training, circuit training, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial,*

randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. In PubMed we found and reviewed 687 articles, and considered 124 for inclusion. In Scopus, we found and reviewed 2,373 articles, and considered 11 for inclusion. In CINAHL, we found and reviewed 111 articles, and considered 1 for inclusion. In Cochrane Library, we found and reviewed 13 articles, and considered 0 for inclusion. We also considered for inclusion 37 articles from other sources. Of the 173 articles considered for inclusion, 139 randomized trials and 34 systematic studies met the inclusion criteria.

## Medications

### Non-steroidal Anti-inflammatory Drugs (NSAIDs) and Acetaminophen

Nonsteroidal anti-inflammatory drugs (NSAIDs) have been utilized to treat musculoskeletal pain, although the exact mechanism of efficacy remains unclear. While they inhibit prostaglandin synthesis and thus impair inflammation, many of the MSDs do not have significant inflammation, including cervicothoracic pain. NSAIDs also have potent analgesic capabilities. These medications, as well as medications to counter gastrointestinal effects, are reviewed in detail in the Hip and Groin Disorders guideline.

There are four commonly used cytoprotective classes of drugs: misoprostol, sucralfate, double-dose histamine Type 2 receptor blockers (famotidine, ranitidine, cimetadine, etc.), and proton pump inhibitors (esomeprazole, lansoprazole, omeprazole, pantoprazole, rabeprazole). There probably are not substantial differences in efficacy for prevention of gastrointestinal bleeding,(665) 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. There also are combination products of NSAIDs/misoprostol that have documented reductions in risk of endoscopic lesions. Providers are cautioned that H2 blockers might not protect from gastric ulcers(666-668) (see Hip and Groin Disorders guideline).

1. *Recommendation: NSAIDs for Acute, Subacute, Chronic, or Post-operative Cervicothoracic Pain*

**NSAIDs are recommended for treatment of acute, subacute, chronic, or post-operative cervicothoracic pain.**

*Indications* – Acute, subacute, chronic, or post-operative cervicothoracic pain; over-the-counter (OTC) agents may suffice and be tried first.

*Frequency/Duration* – Scheduled dosage rather than as-needed preferable; as-needed prescriptions may be reasonable for mild or moderate chronic cervicothoracic pain.

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

*Benefits* – Modest reduction in spine pain and earlier recovery.

*Harms* – Gastrointestinal bleeding, other bleeding, and possible delayed fracture healing. Possible elevated cardiovascular risks including myocardial infarction, especially for high-dose COX-2 inhibitors. Renal failure may occur particularly in the elderly or those with otherwise compromised function.

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

*Level of Confidence* – **High**

2. *Recommendation: NSAIDs for Acute, Subacute, or Chronic Cervicothoracic Radicular Pain Syndromes*

**NSAIDs are recommended for treatment of cervicothoracic radicular pain syndromes.**

*Indications* – Radicular pain syndromes.

*Frequency/Duration* – In acute radicular pain syndromes, scheduled dosage rather than as needed is preferable; as-needed prescriptions may be reasonable for mild or moderate chronic radicular pain.

*Indications for Discontinuation* – Resolution of symptoms, lack of efficacy, or development of adverse effects that necessitate discontinuation. It should be noted that resolution of radicular symptoms generally takes significantly longer than resolution of acute cervicothoracic pain.

*Benefits* – Modest reduction in spine pain and earlier recovery.

*Harms* – Gastrointestinal bleeding, other bleeding, and possible delayed fracture healing. Possible elevated cardiovascular risks including myocardial infarction, especially for high-dose COX-2 inhibitors. Renal failure may occur particularly in the elderly or those with otherwise compromised function.

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

*Level of Confidence* – **High**

3. *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.**

*Indications* – 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. Risk factors include prior gastrointestinal bleeding, increased age, diabetes mellitus, and smoking.

*Frequency/Duration* – Frequency as recommended by manufacturer.

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

*Benefits* – *Reduced risk of gastrointestinal bleeding when used with an NSAID.*

*Harms* – Misoprostol may cause diarrhea. Other medications typically well tolerated, although as with all medications, allergic intolerances have been reported.

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

*Level of Confidence* – **High**

4. *Recommendation: NSAIDs for Patients at Risk for Cardiovascular Adverse Effects*  
**It is recommended that patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should know the risks and benefits of NSAID therapy for pain discussed.**

*Benefit* – *Counter risk of adverse event.*

*Harms* – *None.*

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

*Level of Confidence* – **High**

**Acetaminophen or aspirin is strongly recommended as the first-line therapy as these appear to be the safest to use for these patients.**

*Frequency/Duration* – 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.(669)

*Benefits* – *Addresses spine pain without increased risk of cardiovascular event.*

*Harms* – Less effective than NSAID. Aspirin also more prone towards gastrointestinal bleeding and other hemorrhage.

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

*Level of Confidence* – **High**

5. *Recommendation: Acetaminophen for Cervicothoracic Pain*  
**Acetaminophen is recommended for treatment of cervicothoracic pain with or without radicular symptoms, particularly for those with contraindications for NSAIDs.**

*Benefits* – *Addresses spine pain without increased risk of cardiovascular event.*

*Harms* – Less effective than NSAID. Aspirin also more prone towards gastrointestinal bleeding and other hemorrhage.

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

*Level of Confidence* – **High**

## Rationale for Recommendations

There is less quality evidence for use of NSAIDs and acetaminophen in cervicothoracic pain compared to low back pain and arthroses (see Low Back Disorders and Hip and Groin Disorders guidelines). A review found only 5 RCTs with a total of 270 people.(670) There are no randomized placebo controlled trials evaluating NSAIDs and cervicothoracic pain. There is evidence that NSAIDs decrease pain in lumbosacral spine pain (see Low Back Disorders guideline) as well as other joint pain.

There is quality evidence that NSAIDs reduce pain and improve functional status among acute, subacute, and chronic cervicothoracic pain patients.(671-674) These RCTs compared NSAIDs to other interventions such as manipulation in acute and subacute cervicothoracic pain,(675, 676) acupuncture(675, 677) and documented improvement with NSAIDs, but did not find a statistically significant improvement compared to the other interventions. Less clear, primarily due to in part to

diagnostic uncertainties, are the beneficial effects that appear to be present for the treatment of radicular pain syndromes.(678)

Results are positive whether considering COX-1 (non-selective) or COX-2 (selective) NSAIDs,(673, 675, 679) although the magnitude of benefit is not generally large for any given medication. There is a dearth of head-to-head comparative trials of NSAIDs. Evidence that one medication is superior to another is lacking for cervicothoracic pain. There also is no strong evidence that any specific dosing pattern is superior.

There are no quality studies of acetaminophen as a single agent in the adult working population. There is one moderate-quality RCT evaluating single dose acetaminophen compared to ibuprofen and codeine in ages 6 to 17 in acute musculoskeletal pain, showing ibuprofen to have more significant pain relief.(674) However, paracetamol, a close analog, has been studied more extensively in subacute/chronic cervicothoracic pain and has some evidence of efficacy.(673, 675) There has not been any evidence that paracetamol is superior or equivalent to NSAIDs.(673)

NSAIDs are not invasive, have low side effect profiles in a healthy working age patient population, and when generic medications are used are low cost. The potential for some NSAIDs to increase the risk of cardiovascular events should be considered and requires additional quality studies to fully address. A recent review should be consulted before prescribing for high cardiovascular risk individuals.(669)

## Evidence for the Use of NSAIDs and Acetaminophen

There are 3 high-(674, 679, 680) and 13 moderate-quality(665-668, 671-673, 675, 676, 681-684) RCTs incorporated into this analysis. There is 1 low-quality RCT in Appendix 1.(677)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: non-steroidal anti-inflammatory, NSAIDs, non-steroidal anti-inflammatory agents, Aspirin (acetylsalicylic acid), Celecoxib, Dexibuprofen, Dexketoprofen, Diclofenac, Diflunisal, Droxicam, Etodolac, Etodolac, Etoricoxib, Fenoprofen, Flurbiprofen, Ibuprofen, Indomethacin, Isoxicam, Ketoprofen, Ketorolac, Lornoxicam, Loxoprofen, Lumiracoxib, Meclofenamic acid, Mefenamic acid, Meloxicam, Nabumetone, Naproxen, Nimesulide, Oxaprozin, Parecoxib, Piroxicam, Rofecoxib, Salsalate (salicylsalicylic acid), Sulindac, Tenoxicam, Tolfenamic acid, Tolmetin, Valdecoxib, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 349 articles, and considered 13 for inclusion. In Scopus, we found and reviewed 201 articles, and considered 2 for inclusion. In CINAHL, we found and reviewed 5 articles, and considered 1 for inclusion. In Cochrane Library, we found and reviewed 16 articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the 16 articles considered for inclusion, 15 randomized trials and zero systematic studies met the inclusion criteria.*

## Anti-Depressants

For many years, anti-depressants have been utilized for the treatment of chronic pain.(685-687) This section addresses the use of anti-depressants specifically to treat cervicothoracic pain with or without depression.

There are two main classes of anti-depressant medication used in the management of pain.(688) The first class – tricyclic anti-depressants (TCAs) – are believed to primarily work through inhibiting the reuptake of norepinephrine and include the antidepressants amitriptyline, doxepin, imipramine, desipramine, nortriptyline, protriptyline, maprotiline, and clomipramine. The second class – the selective serotonin reuptake inhibitors (SSRIs) – includes fluoxetine, sertraline, paroxetine, fluvoxamine, citalopram, and escitalopram. Dual reuptake inhibitors are also available, known as serotonin and norepinephrine reuptake inhibitors or SNRIs, which include duloxetine and venlafaxine. Knowledge of the different classes of agents is critical for the successful treatment of chronic pain. These recommendations are segregated into whether the anti-depressant blocks norepinephrine or not (including dual serotonin-norepinephrine agents), as that appears to be the critical feature that produces efficacy for treatment of pain.



1. *Recommendation: TCAs and SNRIs for Chronic Cervicothoracic Pain*

**Norepinephrine reuptake inhibitor antidepressants (TCAs) and dual reuptake inhibitors (SNRIs) – e.g., amitriptyline, imipramine, nortriptyline, maprotiline, doxepin, duloxetine, and venlafaxine – are recommended for the treatment of chronic cervicothoracic pain.**

*Indications* – Chronic pain not adequately treated with NSAIDs and an active exercise program. This intervention may be particularly helpful if there is nocturnal sleep disruption and mild dysthymia.(689-691)

*Frequency/Duration* – Generally a low dose at night, gradually increased (e.g., amitriptyline 25mg QHS, increased by 25mg each week or Doxepin 50mg up to 300mg (2.5mg/kg)(689, 692) until a sub-maximal or maximal dose is achieved, sufficient effects are achieved, or adverse effects occur. All quality trials utilized lower doses, (e.g., amitriptyline 25 to 75mg a day in part to avoid adverse effects and necessity of blood level monitoring). Imipramine is less sedating, thus if there is carryover daytime sedation, it may be a better option. If the patient cannot sleep at night, amitriptyline is the recommended initial medication to prescribe.

*Indications for Discontinuation* – Resolution of pain, intolerance, lack of efficacy, or development of adverse effects.

*Benefits* – Modest improvements in spine pain. May improve sleep quality.

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

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

*Level of Confidence* – **Moderate**

2. *Recommendation: Serotonin-Norepinephrine Reuptake Inhibitors “SNRIs, aka “Dual Action Agents,” and Tricyclic Antidepressants (TCAs) for Radicular Pain*

**There is no recommendation for or against use of norepinephrine reuptake inhibitor anti-depressants (e.g., tricyclic anti-depressants – amitriptyline, imipramine, nortriptyline, desipramine, maprotiline, doxepin) and mixed serotonin norepinephrine reuptake inhibitors (e.g., duloxetine) for treatment of post-operative or radicular cervicothoracic pain absent other indicators for treatment, as there is no quality evidence supporting their efficacy (See Low Back Disorders Guideline).** They may be a reasonable option for select cases particularly with sleep disruption with concerns regarding habituating agents or inability to manage with NSAIDs or other agents. There is some evidence of efficacy for treatment of patients with proximal limb radiation.(899,906)

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

*Level of Confidence* – **Low**

3. *Recommendation: SSRIs for Acute, Subacute, Chronic, Postoperative Cervicothoracic Pain*

**The selective serotonin reuptake inhibitors, (e.g., paroxetine, as well as bupropion and trazodone) are not recommended for treatment of chronic cervicothoracic pain.** (They may be nevertheless recommended for treatment of depression as noted previously.) There is strong evidence that treatment with these medications is not of benefit in other pain syndromes including low back pain (see Low Back Disorders guideline), thus their use is not recommended for the management of chronic cervicothoracic pain. (Utilization of these medications may still be indicated for treatment of depression).

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

*Level of Confidence* – **Moderate**

4. *Recommendation: Anti-depressants for Acute or Subacute Cervicothoracic Pain*

**Absent other indicators of a need for treatment with TCAs and SNRIs, anti-depressants are not recommended for managing acute or subacute cervicothoracic pain as there is no quality evidence supporting their efficacy and other treatment options have documented efficacy.** Limited use in the late subacute phase may be reasonable.

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

*Level of Confidence* – **Low**

## Rationale for Recommendations

There is quality evidence TCA anti-depressants are effective for treating cervicothoracic pain and muscle tension pain compared with placebo when utilizing doxepin.(689, 690) TCA and SNRI antidepressants have quality evidence for treatment of other chronic spinal pain(693-695) (see Chronic Pain and Low Back Disorders guidelines). A moderate-quality study suggested that fluoxetine was similar to amitriptyline in treatment effect on

chronic spinal pain.(692) However, while there is limited direct evidence for use of SSRIs for treatment of cervicothoracic pain, there is robust evidence that SSRIs are ineffective for treatment of LBP and thus are also not recommended for treatment of cervicothoracic pain (696, 697) (see Chronic Pain and Low Back Disorders guidelines). TCAs and SNRIs are not invasive, have low to moderate adverse effects when used in low doses for treatment of pain, and are low to moderate cost depending on length of treatment. They are recommended for treatment of patients with chronic cervicothoracic pain and cervical radiculopathy that are insufficiently treated with NSAID and an active exercise program.

### **Evidence for the Use of Anti-depressants**

There are 4 moderate-quality RCTs or crossover trials incorporated into this analysis.(689-692)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Antidepressive agents, antidepressant drugs, antidepressants, norepinephrine reuptake inhibitors, TCA, TCAs, MAOIs, SMSs, SARIs, SSRI, SNRIs, Doxepin, Clomipramine, Nortriptyline, Vortioxetine, Citalopram, Duloxetine, Trazodone, Escitalopram, Paroxetine, Fluoxetine, Fluvoxamine, Sertraline, Desvenlafaxine, Levomilnacipran, Milnacipran, Tofenacin, Venlafaxine, Vilazodone, Etoperidone, Viloxazine, Amitriptyline, Butriptyline, Clomipramine, Desipramine, Dosulepin, Imipramine, Iprindole, Lofepamine, Melitracen, Nortriptyline, Trimipramine, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 30 articles, and considered 4 for inclusion. In Scopus, we found and reviewed 316 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 0 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 8 articles, and considered 0 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 4 articles considered for inclusion, 4 randomized trials and 0 systematic studies met the inclusion criteria.*

### **Anti-Epileptic Agents**

Anti-epileptic agents are believed to have analgesic properties and have been utilized off-label for some chronic pain syndromes since the 1960s.(698) These agents have been primarily used to treat neuropathic pain, such as chronic radicular syndromes.(699) Trigeminal neuralgia has also been treated with anti-epileptic agents; however, a Cochrane review reported that there was insufficient evidence of efficacy for that purpose.(700)

Gabapentin, a GABA analog, is an anticonvulsant originally approved by the U.S. Food and Drug Administration (FDA) for treating seizures, particularly in conjunction with other anticonvulsants. The FDA later approved its use as a treatment of post-therapeutic neuralgia. It is prescribed for various pain syndromes including acute or chronic pain, spinal cord injury, Guillain-Barre syndrome and other various neuropathic pain syndromes. (701, 702) The mechanism of action is unknown. It is believed to act directly on the central nervous system, although not at the GABA receptor. Gabapentin is not a controlled substance, but does have psychoactive properties and therefore does carry a slight risk of abuse.

#### **1. Recommendation: Topiramate for Chronic Cervicothoracic Pain**

**Topiramate is recommended for limited use in select patients with chronic cervicothoracic pain as a fourth- or fifth-line agent.**

*Indications for Initiation* – Failure of multiple other modalities including trials of different NSAIDs, aerobic exercise, stretching exercise, strengthening exercise, tricyclic anti-depressants, distractants, and manipulation.

*Frequency/Dose* – Initiate by gradually increasing the dose – beginning dose of 50mg, increasing by 50mg a week.(703) The most appropriate steady dose is unclear, but appears to be 300mg. Patients should be carefully monitored for the development of adverse events.

*Indications for Discontinuation* – Resolution, development of adverse effects, lack of efficacy, or failure to adhere to a functional restoration program. Careful monitoring of employed patients is indicated due in part to elevated risks for central nervous system (CNS) sedating adverse effects.

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

*Level of Confidence* – **Moderate**

#### **2. Recommendation: Carbamazepine for Chronic Radicular or Neuropathic Pain**

**Carbamazepine is recommended as a potential adjunct as a fourth- or fifth-line treatment for chronic radicular or neuropathic pain after attempting other treatments (e.g., different NSAIDs, aerobic exercise, other exercise, manipulation).** While there is not quality evidence for treatment of chronic radicular cervicothoracic pain, a trial of carbamazepine may be considered if other medications have failed. Oxcarbazepine and lamotrigine may be useful agents if there is insufficient relief from carbamazepine.

*Indications for Initiation* – Failure of multiple other modalities including trials of different NSAIDs, aerobic exercise, stretching exercise, strengthening exercise, tricyclic anti-depressants, distractants, and manipulation.

*Frequency/Duration* – Frequency and dosing are based on the medication prescribed.

*Indications for Discontinuation* – Resolution of cervicothoracic pain, lack of efficacy, or development of adverse effects that necessitate discontinuation. Careful monitoring of employed patients is indicated due to elevated risks for CNS-sedating adverse effects.

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

*Level of Confidence* – **Moderate**

3. *Recommendation: Topiramate for Neuropathic Pain*

**Topiramate is not recommended for neuropathic pain, including peripheral neuropathy.(704)**

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

*Level of Confidence* – **Moderate**

4. *Recommendation: Gabapentin for Peri-operative Pain*

**Gabapentin is recommended for peri-operative management of pain to reduce need for opioids, particularly in patients with adverse effects from opioids.**

*Indications* – Peri-operative pain management.

*Frequency/Duration* – Dosing is begun at 300mg q8h, and slowly increased if sedation is not occurring.

*Indications for Discontinuation* – Resolution, lack of efficacy, or intolerance. Careful monitoring of employed patients is indicated due in part to elevated risks for CNS-sedating adverse effects.

*Benefits* –Reduced opioid use, which may potentially speed recovery and produce better outcomes.

*Harms* – Drowsiness, dizziness and other CNS sedating effects are the most common adverse effects. Increased fatalities associated with opioids (1537).

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

*Level of Confidence* – **High**

5. *Recommendation: Gabapentin for Chronic Non-neuropathic or Cervicothoracic Pain*

**Gabapentin is not recommended for chronic non-neuropathic pain or cervicothoracic pain.**

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

*Level of Confidence* – **Low**

6. *Recommendation: Gabapentin for Chronic Radicular Pain Syndromes*

**There is no recommendation for or against the use of gabapentin for chronic radicular pain syndromes as the low back pain evidence is conflicting. (705, 706)**

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

*Level of Confidence* – **Low**

## Rationale for Recommendations

There are no quality studies for cervicothoracic pain disorders. Overall, the quality of the available literature is low for the low back. A high-quality trial compared topiramate to placebo in chronic low back pain. They reported reduced pain and overall improvement in the topiramate group.(703) A moderate-quality trial evaluated topiramate compared to placebo in diabetic polyneuropathy and found no significant difference in pain control.(704) For treatment of low back pain, there is limited evidence of efficacy of carbamazepine. In a moderate-quality trial carbamazepine plus opioids was compared to placebo in peripheral neuropathy patients. Significant delay in pain increase in the carbamazepine group was observed compared to placebo(707) (see Low Back Disorders guideline).

There are no sham-controlled or quality trials evaluating the use of gabapentin or pregabalin for cervicothoracic pain disorders. Gabapentin and the closely related compound pregabalin have been evaluated in quality studies for treatment of

multiple pain syndromes.(702) However, results are not uniformly positive for all conditions (see Chronic Pain guideline for other conditions). There are conflicting results for treatment of chronic low back pain.(705, 706) A meta-analysis failed to find statistical benefit of gabapentinoids for treatment of low back pain, thus raising concerns about efficacy for the cervical spine, and reported several adverse effects (705, 1538-1540). Gabapentin has been shown to reduce post-operative pain and the need for opioids in patients undergoing back surgery(708-711) (see Low Back Disorders guideline).

## Evidence for the Use of Anti-Epileptic Agents

There is 1 other study in Appendix 1.(712)

*Anti-Epileptic Agents – A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Anti-Epileptic agents (Carbamazepine OR Topiramate), cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. In PubMed we found and reviewed 783 articles, and considered 1 for inclusion. In Scopus, we found and reviewed 3 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 0 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 11 articles, and considered 0 for inclusion. We also considered for inclusion 15 articles from other sources. Of the 1 article considered for inclusion, 1 randomized trial and 0 systematic studies met the inclusion criteria.*

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*: gabapentin, pregabalin, cervicgia, pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, postop, postoperative\*, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies to find 262 articles. Of the 262 articles, we reviewed 79 articles and included 2 articles (2 randomized controlled trials and 0 systematic reviews).*

## Capsaicin, “Sports Creams” and Other Creams and Ointments

Capsaicin is the active ingredient in peppers which makes them “hot.” Applied to the skin as a cream or ointment, it is thought to reduce pain by stimulating nerve endings, thus being effective through distraction. Rado-Salil Ointment is a proprietary formulation of 14 agents, the two most common of which are menthol (55.1%) and methylsalicylate (26.5%). There are many other commercial products that similarly cause either a warm or cool feeling in the skin. All of these agents are thought to work through a counter-irritant mechanism (i.e., feel the dermal sensation, rather than feeling cervicothoracic pain). There is evidence that capsaicin compounds should not be used chronically due to reported adverse effects on neurons.(713)

### 1. Recommendation: Capsaicin for Acute, Subacute, and Chronic Cervicothoracic Pain

**Capsaicin (capsicum) is recommended for treatment of acute and subacute cervicothoracic pain or temporary flare-ups of chronic cervicothoracic pain.**

*Indications* – For acute, subacute, and temporary flare-ups of chronic cervicothoracic pain, capsicum is recommended for treatment. Providers should be aware that there are other treatments that appear to likely have greater efficacy (e.g., NSAIDs, progressive exercise program, etc.). However, capsaicin may be a useful adjunct. These compounds may also be used in those patients who prefer topical treatments over oral treatments and other more efficacious treatments, especially if they have but have only mild cervicothoracic pain. Capsaicin appears superior to Spiroflor in low back pain trials.(714) Other creams and ointments may be useful, although there is no quality evidence to guide recommendations.

*Duration/Frequency* – As directed on the product label. Long-term use is not recommended.

*Indications for Discontinuation – Resolution of cervicothoracic pain, lack of efficacy, or development of adverse effects that necessitate discontinuation. It is recommended not to be used for more than 1 month, as the costs become high and patients are recommended to be transitioning to an active treatment program.*

*Benefits – Modest reductions in pain through distraction.*

*Harms – Local irritation and theoretical neuronal death with longer-term use.(715)*

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

*Level of Confidence – Moderate*

2. *Recommendation: Spiroflor for Acute, Subacute, or Chronic Cervical and Thoracic Pain*

**Spiroflor is not recommended for treatment of acute, subacute, or chronic cervical and thoracic pain as it appears less efficacious than capsaicin and there are other treatments that are efficacious.**

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

*Level of Confidence – Low*

3. *Recommendation: Topical NSAIDs or Other Creams and Ointments for Acute, Subacute, or Chronic Cervical and Thoracic Pain*

**There is no recommendation for or against the use of topical NSAIDs or other creams and ointments for treatment of acute, subacute, or chronic cervical and thoracic pain.**

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

*Level of Confidence – Low*

4. *Recommendation: DMSO for Chronic Cervical and Thoracic Pain*

**DMSO is not recommended for treatment of chronic cervical and thoracic pain.**

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

*Level of Confidence – Low*

5. *Recommendation: N-Acetylcysteine for Chronic Cervical and Thoracic Pain*

**N-Acetylcysteine is not recommended for treatment of chronic cervical and thoracic pain.**

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

*Level of Confidence – Low*

6. *Recommendation: EMLA Cream for Chronic Cervical and Thoracic Pain*

**EMLA cream is not recommended for treatment of chronic cervical and thoracic pain.**

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

*Level of Confidence – Low*

7. *Recommendation: Wheatgrass Cream for Chronic Cervical and Thoracic Pain*

**Wheatgrass cream is not recommended for treatment of chronic cervical and thoracic pain.**

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

*Level of Confidence – Low*

8. *Recommendation: Other Creams and Ointments for Acute, Subacute, and Chronic Cervicothoracic Pain*

**There is no recommendation for the use of other creams and ointments for treatment of acute, subacute, or chronic cervicothoracic pain as there is no evidence of efficacy.**

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

*Level of Confidence – Low*

## **Rationale for Recommendations**

There are no quality trials of topical creams for cervicothoracic pain. Capsicum compounds have evidence of efficacy in quality studies in the low back, although they do not appear particularly potent. There are no studies of long-term chronic use, thus no information about long-term efficacy or dermal or other toxicity (see Low Back Disorders guideline).

## **Evidence for the Use of Capsaicin**

There is 1 low-quality RCT in Appendix 1.(716)

*Capsaicin (Capsicum)* – A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: capsaicin, capsicum, sports creams, other creams and ointments neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed, we found and reviewed 58 articles, and considered 3 for inclusion. In Scopus, we found and reviewed 54 articles, and considered zero for inclusion. In CINAHL, we found and reviewed zero articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed zero articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the 3 articles considered for inclusion, 1 randomized trials and 2 systematic studies met the inclusion criteria.

## Lidocaine Patches

Topical lidocaine patches have been increasingly used to treat numerous pain conditions ranging from to carpal tunnel syndrome (CTS) to postherpetic neuralgia.(717, 718)

*Recommendation: Lidocaine Patches for Acute, Subacute, Chronic or Postoperative Cervical and Thoracic Pain*

**Lidocaine patches are not recommended for treatment of acute, subacute, chronic or postoperative cervical and thoracic pain.**

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

*Level of Confidence – Low*

## Rationale for Recommendation

There is one trial on treatment of trapezius pain suggesting possible modest short term benefits that did not last one month.(719) There is one trial failing to show benefit for treatment of low back pain.(720)

## Evidence for the Use of Lidocaine Patches

There is 1 moderate-quality RCT incorporated into this analysis.(719)

*A comprehensive literature search was conducted using PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Lidocaine patch/ Neck Pain, cervicgia, cervical pain, cervical Radiculopathy, radicular pain, postoperative neck pain, postoperative cervical pain, herniated disk; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective, and prospective studies. We found and reviewed 8 articles in PubMed, 48 in Scopus, 0 in CINAHL, 8 in Cochrane Library. We considered for inclusion 8 from PubMed, 48 from Scopus, 0 from CINAHL, 8 from Cochrane Library and 0 from other sources. Of the 64 articles considered for inclusion, 1 randomized trial and 0 systematic studies met the inclusion criteria.*

## Colchicine

Colchicine is a drug that inhibits microtubule formation. Its primary use is in the treatment of acute attacks of gout. Because of its anti-inflammatory properties, it has been used for several decades to treat pain.(721, 722) Thiocolchicoside is a muscle relaxant derived from colchicoside.(723, 724)

1. *Recommendation: Oral and I.V. Colchicine for Acute, Subacute, or Chronic Cervicothoracic Pain*

**Oral and I.V. colchicine are not recommended for acute, subacute, or chronic cervicothoracic pain.**

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

*Level of Confidence – Moderate*

2. *Recommendation: Thiocolchicoside for Acute, Subacute, or Chronic Cervicothoracic Pain*

**There is no recommendation for or against the use of thiocolchicoside for acute, subacute, or chronic cervicothoracic pain.**

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

*Level of Confidence – Low*

## Rationale for Recommendation

There are no quality trials for cervicothoracic pain disorders. There are conflicting studies on the value of colchicine for treatment of low back pain and no studies suggesting prolonged benefits.(721, 722, 724-726) Colchicine and thicolchicoside are not invasive or minimally invasive depending on formulation, have considerable adverse effects, and are low to moderate in cost. In the absence of quality evidence, suggested recommendations for the cervicothoracic spine reflect those for the lumbosacral spine (see Low Back Disorders guideline).

## Evidence for the Use of Oral and I.V. Colchicines

There are no quality studies incorporated into this analysis.

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Neck Pain, cervicgia, cervical Pain, cervical radiculopathy, radicular pain, postoperative neck pain, postoperative cervical pain, herniated disk, cervicgia, neck pain, cervical pain, cervical radiculopathy, radicular pain, herniated disk, postoperative neck pain, postoperative cervical pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 714 articles, and considered 0 for inclusion. In Scopus, we found and reviewed 0 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 0 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 220 articles, and considered 0 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 0 articles considered for inclusion, 0 randomized trials and 0 systematic studies met the inclusion criteria.*

## Systemic Glucocorticosteroids (AKA “Steroids”)

Glucocorticosteroids are used to treat herniated discs primarily through local injections (e.g., epidural glucocorticosteroid injections). It is theorized that these medications reduce localized inflammation and swelling, although they appear to have some capacity to reduce pain. As an alternative to the invasiveness of an injection, pulses of oral glucocorticosteroids or parenteral injections have been used to treat these patients. These medications have also been utilized for treatment of cervical pain, whiplash, and other spine pain (727) (see Low Back Disorders guideline).

### 1. Recommendation: Systemic Glucocorticosteroids for Acute Severe Radicular Pain Syndromes

**Systemic glucocorticosteroids are recommended for treatment of acute and subacute radicular pain.**(728, 729) (Finckh 06; Goldberg 15)

*Indications* – Acute, moderate to severe radicular pain thought to be due to a herniated intervertebral disc.

*Frequency/Dose* – Dosing recommendation is from the highest quality study for lumbar radiculopathy and is Prednisone 60 mg for 5 days, then 40 mg for 5 days, and then 20 mg for 5 days for a combined cumulative dose of 600mg over 15 days.(729)

*Benefits* – Modest short-term reduction in acute and subacute radicular pain compared with placebo and moderately improved long term function.

*Harms* – Insomnia, Headache, joint pain, nervousness, indigestion, sweating.(729) Cumulative steroid doses over time associated with adverse effects including worse glucose control, hypertension, osteoporosis, fractures, osteonecrosis, gastrointestinal bleeding, and infections.

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

*Level of Confidence* – **Moderate**

### 2. Recommendation: Glucocorticosteroids for Acute, Subacute, Chronic or Postoperative Cervical or Thoracic Pain

**Glucocorticosteroids are moderately not recommended for treatment of acute, subacute, chronic or postoperative cervical or thoracic.**

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

*Level of Confidence* – **Moderate**

## Rationale for Recommendation

Glucocorticosteroids to treat radicular pain syndromes have been particularly assessed in quality studies of the lumbar spine (see Low Back Disorders guideline). The highest quality studies have the best definitions of patients and provided better assurance the diagnosis was sciatica/radiculopathy. The highest quality study(729) showed benefits with functional improvement at one year. The next strongest study also showed treatment benefit. Two lower quality negative studies,(730, 731) have less clear case definitions, yet one study suggested a trend towards efficacy among patients with a positive straight-leg raising test.(730) One study that assessed this intervention for treatment of LBP without radicular pain was negative.(732)

Systemic glucocorticosteroids are either minimally invasive or not invasive depending on the route of administration. The highest quality study documents intermediate to long-term improvements in subjective function (ODI) when treating radiculopathy.(729) Adverse effects are mostly manageable for a single short course, yet adverse effects may include avascular necrosis and diabetic patients may have worsened glucose control while using glucocorticoids. It is low cost. By analogy to the lumbar spine, glucocorticosteroids are recommended for management of acute and subacute cervical radicular pain syndromes thought to be due to a herniated intervertebral disc. Glucocorticosteroids are not recommended for management of acute, subacute, chronic and postoperative spine pain.

## Evidence for the Use of Glucocorticosteroids

There is 1 high-quality RCT incorporated into this analysis.(728)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: epidural injection, glucocorticoid, steroid injection, dexamethasone, betamethasone, methylprednisolone, triamcinolone, neck pain, cervicalgia, cervical pain, cervical radiculopathy, radicular pain, postoperative neck pain, postoperative cervical pain, herniated disk, controlled clinical trial, controlled trails, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 148 articles and considered 20 for inclusion. In Scopus, we found and reviewed 620 articles and considered 2 for inclusion. In CINAHL we found and reviewed 8 articles and considered 1 for inclusion. In Cochrane Library we found and reviewed 5 articles and considered 0 for inclusion. We also considered for inclusion 2 articles from other sources. Of the 25 articles considered for inclusion, 14 randomized trials and 8 systematic studies met the inclusion criteria.*

### 2. Recommendation: Glucocorticosteroids for Acute Whiplash Associated Injury

#### **Glucocorticosteroids are recommended for acute whiplash injury Grades II and III.**

*Indications* – Acute whiplash injury, within the first 8 hours after injury in whiplash Grades II and III. (Grade II includes cervical pain and musculoskeletal signs, Grade III includes neurologic signs such as decreased or absent deep tendon reflexes, weakness, numbness or sensory deficits).

*Frequency/Dose* – Single intravenous dose methylprednisolone (30mg/kg over 15 minutes) followed by 45 minute pause, then 23-hour infusion (5.4mg/kg per hour). Patients whose weight was less than 75kg were given half as much methylprednisolone.(727)

*Benefits* – Modestly faster resolution of the pain.

*Harms* – Anxiety, lack of sleep, worse glycemic control, infection. Cumulatively over time with subsequent doses, many other adverse effects including hypertension, adrenal insufficiency via suppression, osteoporosis.

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

*Level of Confidence* – **Low**

### 3. Recommendation: Glucocorticosteroids for Acute, Subacute, or Chronic Cervicothoracic Pain

#### **Glucocorticosteroids are not recommended for acute, subacute, or chronic cervicothoracic pain without radicular pain.**

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

*Level of Confidence* – **Low**

## Rationale for Recommendations

There are no quality trials comparing systemic steroids (oral or I.V. or I.M.) to placebo for treatment of cervical radiculopathy. By analogy to lumbar radiculopathy, it is expected there is limited ability of oral steroids to briefly improve cervical



radiculopathy(728) (see Low Back Disorders guideline). Thus, by inference from lumbar radiculopathy, oral steroids are recommended for limited use in the treatment of radiculopathy patients who have inadequate pain management with NSAIDs and who decline epidural injection.

There is one high-quality, double-blinded, placebo-controlled trial assessing utility of I.V. methylprednisolone in acute Grade II and III whiplash patients and reported significant improvements at 6 months.(727) Improvements included less pain at 6 months, disability and sick leave. The trial did not address adverse effects and had variable dosing by weight, while not reporting baseline weights by groups, thus potentially lowering the study quality somewhat. Nevertheless, an evidence-based recommendation in favor of use for this limited patient population is supportable.

There are no quality studies evaluating oral glucocorticosteroids for acute, subacute, or chronic cervicothoracic pain with or without radiculopathy. However, there is quality evidence that these medications are ineffective for treatment of low back pain. (732) Thus, by inference, they are believed to be ineffective for cervical pain and are not recommended.

Systemic glucocorticosteroids are either minimally invasive or not invasive depending on the chosen route of administration. One study evaluated a dexamethasone tapered dose over 7 days. The regimen was initiated with 64mg on day one, 32mg on Day 2, 16mg on Day 3, 12mg on Day 4, and 8mg Days 5 to 7(730) (see Low Back Disorders guideline). NSAIDs are believed to be more efficacious and are generally preferable. Adverse effects include osteonecrosis (avascular necrosis), particularly from long-term administration, and diabetics will have worsened glucose control; thus, the benefits must be carefully weighed against these risks. These medications are low cost for oral administration, but may be moderate cost for parenteral routes. Thus, based on evidence of efficacy, there are limited indications for these medications.

## Evidence for the Use of Glucocorticosteroids for Whiplash Associated Injury

There is 1 high-quality RCT incorporated into this analysis.(727)

## Tumor Necrosis Factor- $\alpha$ LPHA Inhibitors

See Low Back Pain Guideline.

## Skeletal Muscle Relaxants

Skeletal muscle relaxants comprise a diverse set of pharmaceuticals designed to produce “muscle relaxation” through different mechanisms of action – generally considered to be effects on the central nervous system (CNS) and not on skeletal muscle.(733, 734) Thus, whether or not these drugs have an analgesic effect, their mechanism of action is unknown. In addition, almost every drug in this category produces symptoms of CNS sedation or depression, thus significantly limiting their utility. The consequent limitations imposed are particularly pertinent for patients who operate motor vehicles, machinery, or are otherwise engaged in safety-sensitive positions (crane operators, scaffolding climbers, roofing, air traffic controllers, operators of motorized vehicles, construction workers, law enforcement officers, etc.). The sedation induced by these drugs may improve sleep patterns.

As these drugs produce CNS depression,(735) it may be unsurprising that there is a low but definite risk of abuse. The risk of abuse appears to be substantially lower than with narcotics. However, there are patients in whom abuse has been reported involving some if not all of these agents.(736, 737) Carisoprodol is more commonly abused, since one of its active metabolites is meprobamate.(736) Regardless, caution is recommended in prescribing these agents particularly when a patient has a history of substance abuse or requests specific medications.(738)

Perhaps due to the combination of lack of clear understanding of mechanism(s) of action, significant adverse CNS effects, and abuse potential, clinical guidelines regarding muscle relaxants vary across countries. However, new evidence may lead to stronger conclusions, enabling future guidelines to become more concordant.(739)

### 1. Recommendation: Muscle Relaxants for Moderate to Severe Acute Cervicothoracic Pain

**Muscle relaxants are recommended as a second-line treatment in cases of moderate to severe acute cervicothoracic pain that has not been adequately controlled by NSAIDs.**

*Indications* – Moderate to severe acute cervicothoracic pain; best in patients with clinically palpable muscle spasm, limited ROM, limitation of activities of daily living, and tenderness on palpation with symptoms less than 14 days.(672, 740-743) Caution should be used in prescribing skeletal muscle relaxants for those with a history of depression,

personality disorder, and/or substance addiction/abuse (including alcohol or tobacco) as most of RCTs exclude participants with these co-morbidities.(672, 742-744)

*Frequency/Dose* – Initial dose recommended nocturnally and not during workdays or when patients plan to operate motor vehicles. Daytime use is acceptable in circumstances where there are minimal CNS-sedating effects and little concern about sedation compromising function or safety. If significant daytime somnolence results, the medication may need to be discontinued, particularly if it interferes with performance of work, aerobic exercises, or other components of the rehabilitation plan. It is not recommended that the first dose be taken prior to starting a work shift or operating a motor vehicle or machinery. No significant improvement reported in symptoms between the 5mg and 10mg doses of cyclobenzaprine, but found increased somnolence with 10mg dose; patients taking 10mg dose had the highest incidence of premature discontinuation due to adverse effects.(744) If a muscle relaxant is felt to be necessary in patients with psychological issues noted above, cyclobenzaprine is recommend, as its chemical structure resembles a tricyclic anti-depressant, and addiction and abuse are less likely.<sup>y</sup>

*Indications for Discontinuation* – Resolution of pain, non-tolerance, significant sedating effects that carry over into the daytime, or other adverse effects.

*Benefits* – Modest reduction in acute cervicothoracic pain compared with placebo.

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

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

*Level of Confidence* – **Moderate**

2. *Recommendation: Muscle Relaxants for Mild to Moderate Acute Cervicothoracic Pain*

**Muscle relaxants are not recommended for mild to moderate acute cervicothoracic pain due to problems with adverse effects.**

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

*Level of Confidence* – **Moderate**

3. **Carisoprodol is not recommended for moderate to severe acute cervicothoracic pain that has not been adequately controlled by NSAIDs or for acute exacerbations of chronic pain, or acute post-surgical situations.**

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

*Level of Confidence* – **Moderate**

4. *Recommendation: Muscle Relaxants for Acute Radicular Pain or Post-surgical Use*

**Muscle relaxants are recommended as second- or third-line agents for cases of acute severe radicular pain syndromes or in acute post-surgical patients.**

*Indications* – Moderate to severe radicular pain syndromes or post-surgical pain. In radiculopathy pain relief from “muscle relaxants” would presumably be from an analgesic effect and not from a “muscle relaxant” effect, since radicular pain by definition is neuropathic pain and not muscular pain. Generally, muscle relaxants should be prescribed nocturnally initially and not during workdays or when patients plan on operating motor vehicles. However, other agents may be more efficacious for relieving radicular pain, e.g., NSAIDs.

*Frequency/Dose* – Initial dose to be administered in evening. Daytime use is acceptable in circumstances where there are minimal CNS-sedating effects. If significant daytime somnolence interferes with patients work activities, aerobic exercises, or other rehabilitation activities, then the medication may need to be discontinued.

*Indications for Discontinuation* – Resolution of pain, non-tolerance, lack of efficacy, significant sedating effects that carry over into the daytime, or other adverse effects.

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

*Level of Confidence* – **Low**

5. *Recommendation: Muscle Relaxants for Subacute or Chronic Cervicothoracic Pain*

**Muscle relaxants are not recommended for subacute or chronic cervicothoracic pain as there is no evidence to support their use. Additionally, there are relatively high adverse effect profiles and possible abuse potential.**

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

*Level of Confidence* – **Low**

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<sup>y</sup>Baclofen and Tizanidine are reviewed in studies in the Low Back Disorders guideline. There are no quality trials found for cervical or thoracic spine disorders.

## Rationale for Recommendations

Skeletal muscle relaxants have been evaluated in quality studies, although the quality of studies comparing these agents to placebo are likely overstated due to the unblinding that would be inherent in taking a drug with substantial CNS-sedating effects. Nevertheless, there is quality evidence that skeletal muscle relaxants improve acute cervicothoracic pain, particularly for the first 4 to 7 days.(672, 741, 743, 745, 746) However, a concerning adverse event is the significant potential for CNS sedation which has typically affected between 25 to 50% of patients.(744, 745) Thus, it is recommended that the prescription of skeletal muscle relaxants for daytime use be carefully weighed against the need to drive vehicles, operate machinery, or otherwise engage in occupations where mistakes in judgment may have serious consequences. Skeletal muscle relaxants also have a modest, but significant, potential for abuse(747) and caution should be used when prescribing them for patients with a history of substance abuse or dependence.

Although the mechanism of action is unclear, skeletal muscle relaxants have demonstrated efficacy in acute cervicothoracic pain,(672, 740, 743, 744) have significant adverse effects, and are low cost, especially if generic medications are prescribed. Thus, skeletal muscle relaxants are recommended for select management of moderate to severe acute cervicothoracic pain. There is little evidence of muscle relaxant efficacy for treatment of chronic cervicothoracic pain. They are not recommended for continuous management of subacute or chronic cervicothoracic pain, although they may be recommended for brief management of acute exacerbations in the setting of chronic cervicothoracic pain. (748)

Diazepam appears inferior to skeletal muscle relaxants, (740, 742) has a higher incidence rate of adverse effects, and is addictive. Diazepam is not recommended for use as a skeletal muscle relaxant. Cyclobenzaprine has advantages of lower abuse potential and some chemical analogy to tricyclic anti-depressants.(749)

## Evidence for the Use of Skeletal Muscle Relaxants

There are 2 high-(680, 750) and 12 moderate-quality(672, 740-745, 748, 749, 751-753) RCTs incorporated into this analysis. There is 1 low-quality RCT in Appendix 1.(754) There is fair evidence that cyclobenzaprine, carisoprodol, orphenadrine, and tizanidine are effective compared to placebo in patients with musculoskeletal conditions (primarily acute back or neck pain).

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: muscle relaxants, baclofen, carisoprodol, chlorzoxazone, cyclobenzaprine, dantrone, diazepam, metaxalone, methocarbamol, orphenadrine, tizanidine, neuromuscular blocking agents, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, discs, discs, pain; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 1,227 articles, and considered one for inclusion. In Scopus, we found and reviewed 149 articles, and considered two for inclusion. In CINAHL, we found and reviewed zero articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed 4 articles, and considered zero for inclusion. We also considered for inclusion 2 articles from other sources. Of the 17 articles considered for inclusion, 15 randomized trials and 2 systematic studies met the inclusion criteria.*

## Opioids – Oral, Transdermal, and Parenteral (Includes Tramadol)

Opioids are addressed in a separate guideline. The treatment recommendations are summarized below. See the Opioids guideline for all supporting evidence.

### Acute Pain (Up to 4 Weeks)

1. *Recommendation: Routine Use of Opioids for Treatment of Non-Severe Acute Pain*

**Routine opioid use is strongly not recommended for treatment of non-severe acute pain (e.g., low back pain, sprains, or minor injury without signs of tissue damage).**

*Harms* – May inadequately treat acute, severe pain.

*Benefits* – Faster recovery, less debility, reduced accidents risks, risks of dependency or addiction.

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

*Level of Confidence* – **High**

## 2. Recommendation: Opioids for Treatment of Acute, Severe Pain

Opioids are recommended for treatment of acute, severe pain (e.g., crush injuries, large burns, severe fractures, injury with significant tissue damage) uncontrolled by other agents and/or with functional deficits caused by pain. They also may be indicated at the initial visit for a brief course for anticipated pain accompanying severe injuries (i.e., failure of other treatment is not mandatory). A Schedule IV<sup>vi</sup> opioid may be indicated if there is true allergy to NSAIDs and acetaminophen, other contraindication to an alternative medication, or insufficient pain relief with an alternative. Recommend to taper off opioid use in 1 to 2 weeks.

*Indications* – Patients should meet all of the following:

- 1) Severe injury with a clear rationale for use (objective functional limitations due to pain resulting from the medical problem, e.g., extensive trauma such as forearm crush injury, large burns, severe radiculopathy).<sup>vii</sup>
- 2) Other more efficacious treatments should have been instituted,<sup>viii</sup> and either:
  - 2a) failed and/or
  - 2b) have reasonable expectations of the immediate need for an opioid to obtain sleep the evening after the injury.
- 3) Where available, prescription databases (usually referred to as Prescription Drug Monitoring Program (PDMP)) should be checked and not show evidence for conflicting opioid prescriptions from other providers or evidence of misreporting.<sup>ix</sup>
- 4) Non-opioid prescriptions (e.g., NSAIDs, acetaminophen) absent contraindication(s) should nearly always be the primary treatment and accompany an opioid prescription.
- 5) Low-dose opioids may be needed in the elderly who have greater susceptibility to the adverse risks of opioids. Those of lower body weight may also require lower opioid doses.
- 6) Dispensing quantities should be only what is needed to treat the pain. Short-acting opioids are recommended for treatment of acute pain. Long-acting opioids are not recommended.
- 7) Due to greater than 10-fold elevated risks of adverse effects and death, considerable caution is warranted among those using other sedating medications and substances including: i) benzodiazepines; ii) anti-histamines (H<sub>1</sub>-blockers); and/or iii) illicit substances.(457, 755-757) Patients should not receive opioids if they use illicit substances unless there is objective evidence of significant trauma or moderate to severe injuries. Considerable caution is also warranted among those who are unemployed as the reported risks of death are also greater than 10-fold.(457, 756) Due to elevated risk of death and adverse effects, caution is also warranted when considering prescribing an opioid for patients with any of the following characteristics: depression, anxiety, personality disorder, untreated sleep disorders, substance abuse history, current alcohol use or current tobacco use, attention deficit hyperactivity disorder (ADHD), post-traumatic stress disorder (PTSD), suicidal risk, impulse control problems, thought disorders, psychotropic medication use, chronic obstructive pulmonary disease (COPD), asthma, or recurrent pneumonia.(756, 758-779) Considerable caution is also warranted among those with other comorbidities such as chronic hepatitis and/or cirrhosis,(780) as well as coronary artery disease, dysrhythmias, cerebrovascular disease, orthostatic hypotension, asthma, recurrent pneumonia, thermoregulatory problems, advanced age (especially with mentation issues, fall risk, debility), osteopenia, osteoporosis, water retention, renal failure, severe obesity, testosterone deficiency, erectile dysfunction, abdominal pain, gastroparesis, constipation, prostatic hypertrophy, oligomenorrhea, pregnancy, human immunodeficiency virus (HIV), ineffective birth control, herpes, allodynia, dementia, cognitive dysfunction and impairment, gait problems, tremor, concentration problems, insomnia, coordination problems, and slow reaction time. There are considerable drug-drug interactions that have been reported (see Appendices 2-3 of the Opioids guideline).

*Frequency/Duration* – Generally, opioids should be prescribed at night or while not working.(781) Lowest effective, short-acting opioid doses are preferable as they tend to have the better safety profiles, less risk of escalation,(782) less risk of lost time from work,(783) and faster return to work.(784) Short-acting opioids are recommended for treatment of acute pain and long-acting opioids are not recommended. Recommend opioid use as required by pain, rather than in regularly scheduled

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<sup>vi</sup>USA classifies controlled substances that includes a classification system, ranging from Class I to Class V corresponding to lower risks of abuse and dependence. Class I includes substances with a high potential for abuse and without a recognized medical use (e.g., heroin, marijuana, LSD). Class II includes most opiates, amphetamines and cocaine. Class III includes buprenorphine, dihydrocodeine, hydrocodone/codeine when compounded with an NSAID, Marinol. Class IV includes tramadol (in some states), carisoprodol, benzodiazepines, and long-acting barbiturates. Class V includes small amounts of codeine (e.g, 30mg, 60mg).

<sup>vii</sup>Other indications beyond the scope of this guideline include acute myocardial infarction or agitation interfering with acute trauma management.

<sup>viii</sup>Treatments to have tried generally include NSAIDs and acetaminophen. For LBP patients, additional considerations include muscle relaxants, progressive aerobic exercise, and directional exercise.

<sup>ix</sup>Exceptions such as acute, severe trauma should be documented.

dosing. If parenteral administration is required, ketorolac has demonstrated superior efficacy compared with opioids for acute severe pain,(785, 786) although ketorolac’s risk profile may limit use for some patients. Parenteral opioid administration outside of obvious acute trauma or surgical emergency conditions is almost never required, and requests for such treatment are clinically viewed as red flags for potential substance abuse.

*Indications for Discontinuation* – Resolution of pain, sufficient improvement in pain, intolerance or adverse effects, non-compliance, surreptitious medication use, consumption of medications or substances advised to not take concomitantly (e.g., sedating medications, alcohol, benzodiazepines), or use beyond 2 weeks.

*Harms* – Adverse effects are many (see section below on “Opioids Benefits and Harms”).

*Benefits* – Improved short-term pain control.

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

*Level of Confidence* – **High**

### 3. Recommendation: Screening Patients Prior to Initiation of Opioids

**Initial screening of patients is recommended with more detailed screening for: i) requiring continuation of opioids beyond 2 weeks for those with an acute severe injury, and ii) at consideration of initiation for severe pain but no objective evidence.** Screening should include history(ies) of depression, anxiety, personality disorder, other psychiatric disorder, substance abuse, sedating medication use (e.g., anti-histamine/anti-H<sub>1</sub> blocker(756)), benzodiazepine use, opioid dependence, alcohol abuse, current tobacco use, other substance use history, COPD, PTSD, other psychotropic medications, (severe) obesity, cognitive impairment, balance problems/fall risk, osteoporosis, and renal failure (see Appendix 1 of the Opioids guideline). Those who screen positive, especially to multiple criteria, are recommended to: i) undergo greater scrutiny for appropriateness of opioids (may include psychological evaluation); ii) consideration of consultation and examination(s) for complicating conditions and/or appropriateness of opioids; and iii) if opioids are prescribed, more frequent assessments for compliance, achievement of functional gains,(457, 459, 787) adverse effects, and symptoms and signs of aberrancy.

*Harms* – Negligible. If a consultation is needed, there are additional costs that are incurred.

*Benefits* – Improved identification of more appropriate candidates for opioids. Identification of patients at increased risk of adverse effects. In cases where someone has elevated, but potentially acceptable risk, may alert the provider to improve surveillance for complications and aberrant behaviors.

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

*Level of Confidence* – **High**

### 4. Recommendation: Opioid Dose Limits in Acute Pain

**Dispense only that which is required. The maximum daily oral dose recommended for opioid-naïve, acute pain patients based on risk of overdose/death is 50mg morphine equivalent dose (MED)<sup>x</sup>(788)** (see Figure 2. Death Rate (Hazard Ratio) vs. Morphine Equivalent Dosage (mg/d)\*). In rare cases with documented functional improvement (see Appendix 1 of the Opioids guideline), higher doses may be considered, however, risks are substantially higher and greater monitoring is also recommended (see Subacute/Chronic Opioid recommendations below). Lower doses should be used for patients at higher risk of dependency, addiction and other adverse effects. Monitoring is also recommended and consultation may be considered for those patients on higher doses.

*Harms* – Theoretical potential to undertreat pain in some patients with increased pain sensitivity.

*Benefits* – Reduced risk for adverse physical and cognitive effects, dependency, addiction and opioid-related overdoses and deaths.

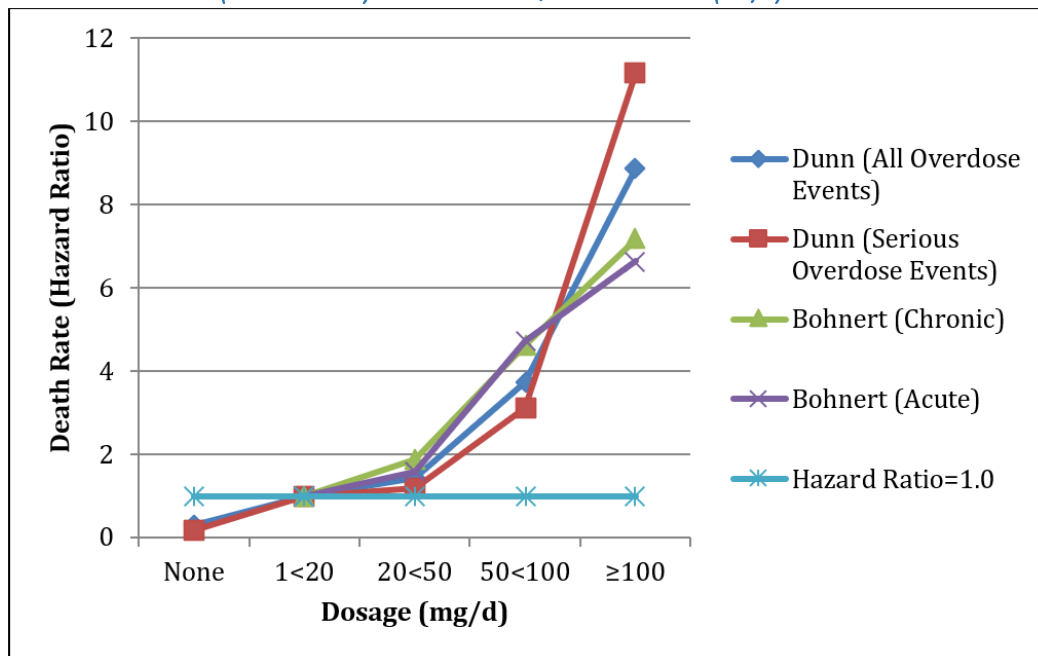
*Strength of Evidence* – **Recommended, Evidence (C)**

*Level of Confidence* – **Moderate**

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<sup>x</sup>Statistical significance present for acute and chronic pain at and above 50mg per day of oral morphine equivalent dose.

FIGURE 2. DEATH RATE (HAZARD RATIO) VS. MORPHINE EQUIVALENT DOSAGE (MG/D)\*



Adapted from Dunn 2010 and Bohnert 2011.

\*Statistical significance present for acute and chronic pain at and above 50 mg per day of oral morphine equivalent dose.

### Post-Operative Pain (Up to 4 Weeks) (After 4 weeks, see Subacute Pain)

Oral opioids are commonly prescribed after sinus surgery,(789) (Church 06) major noncardiac surgical procedures,(790) mastectomy and immediate breast reconstruction (IBR),(791, 792) coronary artery bypass graft surgery,(793) major abdominal surgery (abdominal laparoscopic, abdominal hysterectomy, bowel resection or radical hysterectomy),(794-797) orthopedic surgery,(798) and molar extraction.(799)

#### 1. Recommendation: Limited Use of Opioids for Post-operative Pain

**Limited use of opioids is recommended for post-operative pain management as adjunctive therapy to more effective treatments.**

*Indications* – For post-operative pain management, a brief prescription of short-acting opioids as adjunct to more efficacious treatments (especially Cox-2 NSAIDs such as celecoxib, non-selective NSAIDs after risk of bleeding is no longer a concern).<sup>xi</sup> A brief course of opioids is often needed for minor surgical procedures. However, minor wound laceration repairs often require no opioids. Evidence suggests perioperative pregabalin for 14 days and/or continuous femoral nerve catheter analgesia instead of solely using oral opioids results in superior knee arthroplasty functional outcomes with less venous thromboses.(800) Additional considerations include:

- 1) Non-opioid prescriptions (e.g., NSAIDs, acetaminophen) should nearly always be the primary treatment and accompany an opioid prescription. Computerized programs may also assist in optimal management.(801)
- 2) The lowest effective dose of a short-acting opioid should be used,(782) as well as weaker opioids if possible.(783, 784)
- 3) Short-acting opioids are recommended for treatment of acute pain.
- 4) Dispensing should be only what is needed to treat the pain.<sup>xii</sup>
- 5) Long-acting opioids are not recommended.
- 6) Low-dose opioids may be needed in the elderly who have greater susceptibility to the adverse risks of opioids. Those of lower body weight may also require lower opioid doses.
- 7) Where available, prescription databases (usually referred to as Prescription Drug Monitoring Program (PDMP)) should be checked for other opioid prescriptions. Due to greater than 10-fold elevated risks of adverse effects and death, considerable caution is warranted among those using other sedating medications and substances including: i)

<sup>xi</sup>More efficacious treatments also include therapeutic exercises, e.g., progressive ambulation especially for moderate to extensive procedures (e.g., arthroplasty, fusion).

<sup>xii</sup>Generally, this should be sufficient to cover two weeks of treatment. Prescriptions of 90-day supplies in the post-operative setting are not recommended.

benzodiazepines, ii) anti-histamines (H<sub>1</sub>-blockers), and/or iii) illicit substances.(457, 755-757) Patients should not receive opioids if they use illicit substances unless there is objective evidence of significant trauma or moderate to severe injuries. Considerable caution is also warranted among those who are unemployed as the reported risks of death are also greater than 10-fold.(457, 756)

Due to elevated risk of death and adverse effects, caution is also warranted when considering prescribing an opioid for patients with any of the following characteristics: depression, anxiety, personality disorder, ADHD, PTSD, suicidal risk, impulse control problems, thought disorders, psychotropic medication use, substance abuse history, current alcohol use or current tobacco use, untreated sleep disorders, COPD, asthma, or recurrent pneumonia.(756, 758-779) Considerable caution is also warranted among those with other comorbidities such as chronic hepatitis and/or cirrhosis,(780) as well as coronary artery disease, dysrhythmias, cerebrovascular disease, orthostatic hypotension, thermoregulatory problems, advanced age (especially with mentation issues, fall risk, debility), osteopenia, osteoporosis, water retention, renal failure, severe obesity, testosterone deficiency, erectile dysfunction, abdominal pain, gastroparesis, constipation, prostatic hypertrophy, oligomenorrhea, pregnancy, HIV, ineffective birth control, herpes, allodynia, dementia, cognitive dysfunction and impairment, gait problems, tremor, concentration problems, insomnia, coordination problems, and slow reaction time. There are considerable drug-drug interactions that have been reported (see Appendices 2-3 of the Opioids guideline).

Inpatient management may moderate these recommendations provided there is careful monitoring, although these same management issues then apply post-discharge.

- 8) For patients taking opioids chronically prior to surgery, consultations with anesthesiology and/or pain management are generally needed as post-operative dosing may be very high and management is often quite challenging.
- 9) Ongoing prescriptions of opioids after the immediate post-operative period should generally be for patients who have undergone a major surgery or have other condition(s) necessitating opioids. Most patients should be making progress towards functional restoration, pain reduction and weaning off the opioids. Patients who have not progressed should be carefully evaluated for physical complications or psychiatric comorbidity, adherence to active treatments, and pending development of addiction or dependency.

*Frequency/Duration* – For moderate and major surgeries, opioids are generally needed on a scheduled basis in the immediate post-operative period. Other post-operative situations may be sufficiently managed with an as needed opioid prescription schedule. Provision of opioids sufficient to participate in therapeutic exercise (e.g., progressive ambulation) and allow sleep may be needed. However, high dose use at night is not recommended due to respiratory depression and disruption of sleep architecture. Weaning should begin as soon as function is recovering and pain is subsiding. Subsequent weaning to as needed opioid use is recommended.

*Indications for Discontinuation* – The physician should discontinue the use of opioids based on sufficient recovery, expected resolution of pain, lack of efficacy, intolerance or adverse effects, non-compliance, surreptitious medication use, self-escalation of dose, or use beyond 3 to 5 days for minor procedures, and 2 to 3 weeks for moderate/less extensive procedures. Use for up to 3 months may occasionally be necessary during recovery from more extensive surgical procedures (e.g., spine fusion surgery). However, with rare exceptions, only nocturnal use is recommended in months 2 to 3 plus institution of management as discussed in the subacute/chronic guidelines below. For those requiring opioid use beyond 1 month, the subacute/chronic opioid use recommendations below apply.

*Harms* – Adverse effects are many (see Opioids Guideline).

*Benefits* – Improved short-term, post-operative pain control. Some studies suggest this may modestly improve functional outcomes in the post-operative population.

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

*Level of Confidence* – **High**

## *2. Recommendation: Screening Patients Prior to Continuation of Opioids*

**Screening of patients is recommended for patients requiring continuation of opioids beyond the second post-operative week.** Screening should include history(ies) of: depression, anxiety, personality disorder, pain disorder, other psychiatric disorder, substance abuse history, sedating medication use (e.g., anti-histamine/anti-H<sub>1</sub> blocker), benzodiazepine use, opioid dependence, alcohol abuse, current tobacco use, and other substance use history, COPD, PTSD, other psychotropic medications, (severe) obesity, cognitive impairment, balance problems/fall risk, osteoporosis, and renal failure (see Appendix 1 of the Opioids guideline). Those who screen positive, especially to multiple criteria, are recommended to: i) undergo greater scrutiny for appropriateness of opioids (e.g., may include psychological and/or pain evaluation); ii) compliance with active therapies (e.g., ambulation and other exercise after arthroplasty); iii) consider consultation examination(s) for

complicating conditions and/or appropriateness of opioids; and iv) if ongoing opioids are prescribed, ensure more frequent assessments for treatment compliance, achievement of functional gains,(457, 459, 787) and symptoms and signs of aberrancy.

*Harms* – Negligible. If a consultation is needed, there are additional costs that are incurred.

*Benefits* – Identification of patients at increased risk of adverse effects. Improved identification of more appropriate and safe candidates for opioids compared with attempting post-operative pain control with non-opioids. This should reduce adverse effects. In cases where someone has elevated, but potentially acceptable risk, this may alert the provider to improve surveillance for complications and aberrant behaviors.

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

*Level of Confidence* – **High**

### 3. Recommendation: Opioid Dose Limits in Post-operative Pain

**The maximum daily oral dose recommended for opioid-naïve, acute pain patients based on risk of overdose/death is 50mg morphine equivalent dose (MED)<sup>xiii</sup>(788)** (see Figure 2. Death Rate (Hazard Ratio) vs. Morphine Equivalent Dosage (mg/d)\*). Post-operative patients particularly require individualization due to factors such as the severity of the operative procedure, response to treatment(s) and variability in response. Higher doses beyond 50mg MED may be particularly needed for major surgeries in the first two post-operative weeks to achieve sufficient pain relief, however, greater caution and monitoring are warranted and reductions below 50mg MED at the earliest opportunity should be sought. Lower doses should be used for patients at higher risk of dependency, addiction and other adverse effects. In rare cases with documented functional improvement, ongoing use of higher doses may be considered, however, risks are substantially higher and greater monitoring is also recommended (see Subacute (1-3 Months) and Chronic Pain (>3 Months) opioid recommendations).

*Harms* – Theoretical potential to undertreat pain, which could modestly delay functional recovery.

*Benefits* – Reduced risk for adverse effects, dependency, addiction and opioid-related deaths.

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

*Level of Confidence* – **Low**

## Subacute (1-3 Months) and Chronic Pain (>3 Months)

### 1. Recommendation: Routine Use of Opioids for Subacute and Chronic Non-malignant Pain

**Opioid use is moderately not recommended for treatment of subacute and chronic non-malignant pain. Opioid prescription should be patient specific and limited to cases in which other treatments are insufficient and criteria for opioid use are met (see below).**

*Harms* – May inadequately treat severe subacute or chronic pain.

*Benefits* – Less debility, fewer adverse effects, reduced accident risks, lower risks of dependency, addiction, overdoses, and deaths.

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

*Level of Confidence* – **High**

### 2. Recommendation: Opioids for Treatment of Subacute or Chronic Severe Pain

**The use of an opioid trial is recommended if other evidence-based approaches for functional restorative pain therapy have been used with inadequate improvement in function.(802, 803) Opioids are then recommended for treatment of function impaired by subacute or chronic severe pain (e.g., inability to work due to any of the following: chronic severe radiculopathy, chronic severe peripheral neuropathies, complex regional pain syndrome (CRPS), and severe arthroses) (459) (see Appendix 1 of the Opioids guideline).**

*Indications* – Patients should meet all of the following:

- 1) Reduced function is attributable to the pain. Pain or pain scales alone are insufficient reasons.(456-462, 804-810)
- 2) A severe disorder warranting potential opioid treatment is present [e.g., CRPS, severe radiculopathy, advanced degenerative joint disease (DJD)].(805)
- 3) Other more efficacious treatments have been documented to have failed.(805) Other approaches that should have been first utilized include physical restorative approaches, behavioral interventions, self-applied modalities, non-opioid medications (including NSAIDs, acetaminophen, topical agents, norepinephrine adrenergic reuptake blocking antidepressants or dual reuptake inhibitors; also antiepileptic medications particularly for neuropathic pain) and

<sup>xiii</sup>Statistical significance present for acute and chronic pain at and above 50 mg per day of morphine equivalent dose.



functional restoration. For LBP patients, this also includes<sup>xiv</sup> fear avoidant belief training and ongoing progressive aerobic exercise, and strengthening exercises. For CRPS patients, this includes progressive strengthening exercise. For DJD, this includes NSAIDs, weight loss, aerobic and strengthening exercises.

- 4) An ongoing active exercise program is prescribed and complied with.
- 5) Non-opioid prescriptions (e.g., NSAIDs, acetaminophen) absent a contraindication should nearly always be the primary pain medication and accompany an opioid prescription. Other medications to consider include topical agents, norepinephrine adrenergic reuptake blocking antidepressants or dual reuptake inhibitors; also antiepileptic medications particularly for neuropathic pain).
- 6) The lowest effective dose should be used.(782) Weaker opioids should be used whenever possible.(783, 784) Meperidine is not recommended for chronic pain due to bioaccumulation and adverse effects.
- 7) Low-dose opioids may be needed in the elderly who have greater susceptibility to the adverse risks of opioids. Those of lower body weight may also require lower opioid doses.
- 8) Dispensing should be only what is needed to treat the pain.<sup>xv</sup>
- 9) Extended-release/long-acting opioids are recommended to be used on a scheduled basis, rather than as needed.(805) As needed opioids should generally be avoided for treatment of chronic pain, although limited use for an acute painful event (e.g., fracture, sprain) is reasonable. Sublingual fentanyl is not recommended for treatment of subacute or chronic pain. Caution is warranted with fentanyl patches due to unpredictable absorption.
- 10) Where available, prescription databases (usually referred to as Prescription Drug Monitoring Program or PDMP) should be checked for conflicting opioid prescriptions from other providers or evidence of misreporting.
- 11) Due to greater than 10-fold elevated risks of adverse effects and death, considerable caution is warranted among those using other sedating medications and substances including: i) benzodiazepines; ii) anti-histamines (H<sub>1</sub>-blockers); and/or iii) illicit substances.(457, 755-757) Patients should not receive opioids if they use illicit substances unless there is objective evidence of significant trauma or moderate to severe injuries. Considerable caution is also warranted among those who are unemployed as the reported risks of death are also greater than 10-fold.(457, 756)

Due to elevated risk of death and adverse effects, caution is also warranted when considering prescribing an opioid for patients with any of the following characteristics: depression, anxiety, personality disorder, untreated sleep disorders, substance abuse history, current alcohol use or current tobacco use, ADHD, PTSD, suicidal risk, impulse control problems, thought disorders, psychotropic medication use, COPD, asthma, recurrent pneumonia.(756, 758-779) Considerable caution is also warranted among those with other comorbidities such as chronic hepatitis and/or cirrhosis,(780) as well as coronary artery disease, dysrhythmias, cerebrovascular disease, orthostatic hypotension, asthma, recurrent pneumonia, thermoregulatory problems, advanced age (especially with mentation issues, fall risk, debility), osteopenia, osteoporosis, water retention, renal failure, severe obesity, testosterone deficiency, erectile dysfunction, abdominal pain, gastroparesis, constipation, prostatic hypertrophy, oligomenorrhea, pregnancy, HIV, ineffective birth control, herpes, allodynia, dementia, cognitive dysfunction and impairment, gait problems, tremor, concentration problems, insomnia, coordination problems, and slow reaction time. There are considerable drug-drug interactions that have been reported (see Appendices 2-3 of the Opioids guideline).

*Frequency/Duration* – Opioids use is generally initiated as a “trial” to ascertain whether the selected opioid produces functional improvement (see Appendix 1 of the Opioids guideline). Opioid use is generally prescribed on a regular basis,(811) at night or when not at work.(781) Only one opioid is recommended to be prescribed in a trial. More than one opioid should rarely be used. Lower opioid doses are preferable as they tend to have the better safety profiles, less risk of dose escalation,(782) less work loss,(783) and faster return to work.(784) Patients should have ongoing visits to monitor efficacy, adverse effects, compliance and surreptitious medication use. Opioid prescriptions should be shorter rather than longer duration.(812)

*Indications for Discontinuation* – Opioids should be discontinued based on lack of functional benefit(803) (see Appendix 1 of Opioids Guideline), resolution of pain, improvement to the point of not requiring opioids, intolerance or adverse effects, non-compliance, surreptitious medication use, medication misuse (including self-escalation and sharing medication), aberrant drug screening results, diversion, consumption of medications or substances advised to not take concomitantly (e.g., sedating medications, alcohol, benzodiazepines).

*Harms* – Adverse effects are many (see Opioids Guideline). May initiate path to opioid dependency.

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<sup>xiv</sup>A previous trial of a muscle relaxant is generally recommended. However, if an opioid trial is contemplated, cessation of all depressant medications including muscle relaxants is advisable.

<sup>xv</sup>Generally, this should be sufficient to cover one week of treatment at a time during the trial phase. If a trial is successful at improving function, prescriptions for up to 90-day supplies are recommended.

*Benefits* – Improved short-term pain ratings. Theoretical potential to improve short-term function impaired by a painful condition.

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

*Level of Confidence* – **Low**

### 3. Recommendation: Screening Patients Prior to Initiation of Opioids

**Screening of patients is recommended prior to consideration of initiating a trial of opioids for treatment of subacute or chronic pain.** Screening should include history(ies) of depression, anxiety, personality disorder and personality profile,(784, 813, 814) other psychiatric disorder, substance abuse history, sedating medication use (e.g., anti-histamine/anti-H<sub>1</sub> blocker),(767) benzodiazepine use, opioid dependence, alcohol abuse, current tobacco use, and other substance use history, COPD, PTSD, other psychotropic medications, (severe) obesity, cognitive impairment, balance problems/fall risk, osteoporosis, and renal failure (see Appendix 1 of the Opioids guideline). Those who screen positive, especially to multiple criteria, are recommended to: i) undergo greater scrutiny for appropriateness of opioids (may include psychological and/or psychiatric evaluation(s) to help assure opioids are not being used instead of appropriate mental health care); ii) consideration of consultation and examination(s) for complicating conditions and/or appropriateness of opioids; and iii) if opioids are prescribed, more frequent assessments for compliance, achievement of functional gains and symptoms and signs of aberrant use.

*Harms* – Negligible. If a consultation is needed, there are additional costs that are incurred.

*Benefits* – Identification of patients at increased risk of adverse effects. Improved identification of more appropriate and safe candidates for treatment with opioids. This should reduce adverse effects. In cases where someone has elevated, but potentially acceptable risk, this may alert the provider to improve surveillance for complications and aberrant behaviors.

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

*Level of Confidence* – **High**

### 4. Recommendation: Opioid Dose Limits in Subacute and Chronic Pain

**The maximum daily oral dose recommended for subacute or chronic pain patients based on risk of overdose/death is 50 mg Morphine Equivalent Dose (MED).(760, 788)** In rare cases with documented functional improvements occurring with use above 50mg MED, subsequent doses up to 100mg may be considered, however, risks of death are much greater and more intensive monitoring is then also recommended. Lower doses should be considered in high risk patients. Caution appears warranted in all patients as there is evidence the risk of dose escalation is present even among patients enrolled in a “hold the line (Stable Dose) prescribing strategy” treatment arm.(815) For those whose daily consumption is more than 50mg MED, greater monitoring is recommended to include: i) at least monthly to not more than quarterly appointments with greater frequencies during trial, dose adjustments and with greater co-morbid risk factors and conditions; ii) at least semiannual attempts to wean below 50 mg MED if not off the opioid; iii) at least semiannual documentation of persistence of functional benefit, iv) at least quarterly urine drug screening (see 6. *Recommendation: Urine Drug Screening*); and v) at least semiannual review of medications, particularly to assure no sedating medication use (e.g., benzodiazepine, sedating anti-histamines).

*Harms* – None in a short-term trial. For chronic pain patients, theoretical potential to undertreat pain and thus impair function. However, there is no quality literature currently available to support that position.

*Benefits* – Reduced risk for adverse effects, dependency, addiction, and opioid-related deaths.

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

*Level of Confidence* – **High**

### 5. Recommendation: Use of an Opioid Treatment Agreement (Opioid Contract, Doctor/Patient Agreement, Informed Consent)

**The use of an opioid treatment agreement (opioid contract, doctor/patient agreement, or informed consent) is recommended to document patient understanding, acknowledgement of potential adverse effects, and agreement with the expectations of opioid use (see Appendix 1 of the Opioids guideline). (802, 816-827) If consent obtained, it is recommended appropriate family members be involved in this agreement.**

*Harms* – Negligible.

*Benefits* – Educates the patient and significant others that these medications are high risk, with numerous adverse effects. It allows for a more informed choice. It provides a framework for initiation of a trial, monitoring, treatment goals, compliance requirement, treatment expectations, and conditions for opioid cessation. It should reduce risk of adverse events and opioid-related deaths, although that remains unproven to date.

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

*Level of Confidence* – **Moderate**

## 6. Recommendation: Urine Drug Screening

**Baseline and random urine drug screening, qualitative and quantitative, is recommended for patients prescribed opioids for the treatment of subacute or chronic pain to evaluate presence or absence of the drug, its metabolites, and other substance(s) use. In certain situations, other screenings (e.g., hair particularly for information regarding remote use(828-833) or blood (for acute toxicity) may be appropriate.**

*Indications* – All patients on opioids for subacute or chronic pain.

*Frequency* – Screening is recommended at baseline, randomly at least twice and up to 4 times a year and at termination. More intensive screening is recommended for those consuming more than 50mg MED (see above). Federal guidelines recommend at least 8 tests a year among those utilizing opioid treatment programs.(834) Screening should also be performed “for cause” (e.g., provider suspicion of substance misuse including over-sedating, drug intoxication, motor vehicle crash, other accidents and injuries, driving while intoxicated, premature prescription renewals, self-directed dose changes, lost or stolen prescriptions, using more than one provider for prescriptions, non-pain use of medication, using alcohol for pain treatment or excessive alcohol use, missed appointments, hoarding of medications, and selling medications). Standard urine drug/toxicology screening processes should be followed (consult a qualified medical review officer).(835-837) If there is an aberrant drug screen result (either positive for unexpected drugs or unexpected metabolites or unexpectedly negative results), there should be a careful evaluation of whether there is a plausible explanation (e.g., drug not tested, drug metabolite not tested, laboratory cutpoint and dosing interval would not capture the drug/metabolite, laboratory error). In the absence of a plausible explanation, those patients with aberrant test results should have the opioid discontinued or weaned.(803)

*Harms* – No adverse clinical effects if properly interpreted.

*Benefits* – Identifies aberrant medication(s) and substance(s) use. Such uses are high-risk for opioid events including fatalities (see tables below). It provides objective evidence to cease an opioid trial or ongoing treatment. Identifies patients who may be diverting medication (those screening negative for prescribed medication).

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

*Level of Confidence* – **High**

## Evidence for the Use of Opioids

There are 3 high-(674, 838, 839) and 2 moderate-quality RCTs(671, 840) incorporated into this analysis. There is 1 other study in Appendix 1.(841) See also the Opioids guideline.

## Complementary or Alternative Methods or Dietary Supplements, Etc.

As cervicothoracic pain may last for extended periods of time, it is not surprising that many interventions have been attempted, including some that might be classified as herbal dietary supplements or as complementary or alternative treatments.(842-844) There are many other interventions shown to be efficacious for the treatment of acute, subacute, and chronic cervicothoracic pain, and it is strongly recommended that patients be treated with therapies proven to be efficacious for these conditions.

*Recommendation: Complementary or Alternative Treatments or Dietary Supplements, etc., for Acute, Subacute, or Chronic Cervicothoracic Pain*

**There is no recommendation for or against use of willow bark (Salix), ginger extract, rose hips, camphora molmol, maleluca alternifolia, angelica sinensis, aloe vera, thymus officinalis, menthe peperita, arnica montana, curcuma longa, tancaetum parthenium, and zingiber officinalis, avocado soybean unsaponifiables, oral enzymes, topical copper salicylate, S-Adenosylmethionine, and diacerein harpagoside for acute, subacute and chronic cervicothoracic pain.**

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

*Level of Confidence* – **Low**

## Rationale for Recommendation

There are no quality trials regarding complementary or alternative interventions or dietary supplements, etc. for cervicothoracic pain. Some have conflicting results – e.g., willow bark (Salix), rose hips, avocado soybean unsaponifiables, and ginger extract – for treatment of arthroses (see Hip and Groin Disorders guideline). These interventions are not proven efficacious for the treatment of acute, subacute, or chronic cervicothoracic pain or for radicular pain syndromes. There is strong evidence that harpagoside is effective in the treatment of low back pain (845, 846) (see Low Back Disorders guideline).

However, none of these agents has had a standardized dose, resulting in a lack of clarity of patient dosing. All of the studies comparing the agent to a standard NSAID dose for treatment of arthroses found the NSAID superior; only those with lower doses of NSAIDs sometimes found evidence suggesting equivalency (see Hip and Groin Disorders guideline). These agents are not invasive, have unclear adverse effect profiles and over time are moderate to high cost. There is no recommendation for or against use of these agents.

## Evidence for the Use of Complementary or Alternative Medicine

There are no quality studies incorporated into this analysis.

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Complementary and alternative medicine, and (complementary or alternative methods or dietary supplements, Willow bark (Salix), ginger extract, rose hips, camphora, molmol, maleluca alternifolia, angelica sinensis, aloe vera, thymus officinalis, menthe, peperita, arnica montana, curcuma longa, tancaetum parthenium, and zingiber officinalis, avocado, soybean unsaponifiables, oral enzymes, topical copper salicylate, S-Adenosylmethionine, and diacerein harpagoside), cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. In PubMed we found and reviewed 1282 articles, and considered 1 for inclusion. In Scopus, we found and reviewed 302 articles, and considered 2 for inclusion. In CINAHL, we found and reviewed 4 articles, and considered 2 for inclusion. In Cochrane Library, we found and reviewed 0 articles, and considered 0 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 5 articles considered for inclusion, 0 randomized trials and 5 systematic studies met the inclusion criteria.*

## Vitamins

Vitamins have been used to treat essentially all disorders. There has been particular interest in anti-oxidants; however, it should be noted that all anti-oxidants are simultaneously pro-oxidants.(847, 848) thus evidence of potential harm from vitamins, particularly vitamins A, E, and most recently folate is accumulating.(849-853) There is poor evidence that vitamins or minerals have beneficial therapeutic effects in normal or over-nourished societies.

*Recommendation: Vitamins for Acute, Subacute, Chronic, Post-Operative Cervicothoracic Pain or Radiculopathy*

**The use of vitamins for patients with acute, subacute, chronic, or post-operative cervicothoracic pain and for patients with radiculopathy is not recommended in the absence of documented deficiencies or other nutritional deficit states,**

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

*Level of Confidence – Low*

## Rationale for Recommendation

There is no evidence of vitamin efficacy in cervicothoracic pain. There are also no quality RCTs published in English that provide evidence of vitamin efficacy for use in low back pain (see Low Back Disorders guideline).

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Vitamins, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. In PubMed we found and reviewed 374 articles, and considered 0 for inclusion. In Scopus, we found and reviewed 241 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 40 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 0 articles, and considered 0 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 0 articles considered for inclusion, 0 randomized trials and 0 systematic studies met the inclusion criteria.*

## Allied Health Professionals, Physical and Occupational Therapy, Chiropractic, etc.

As there is no single discipline that solely performs any specific treatment, there are generally no recommendations for or against treatment by or with particular discipline(s). Instead, there is detailed guidance for the interventions irrespective of the profession of the practitioner. However, a practitioner should be experienced in the specific treatment or test being administered.

*Recommendation: Physical Therapy, Occupational Therapy or Other Professionals for Mild to Moderate Acute, Subacute, or Chronic Cervical and Thoracic Pain*

**One or two visits to physical therapy, occupational therapy, or other professionals to initiate and reinforce an exercise program are recommended for mild to moderate acute, subacute, or chronic cervical and thoracic pain.**

*Indications* – Mild to moderate spine pain that is felt to be mostly manageable by self-care.

*Frequency* – One or two visits to initiate and then reinforce an exercise program especially for acute pain. A third appointment may be needed later for a final visit. More appointments may be indicated for establishment and engagement in an active exercise program (see Exercises). For subacute or chronic spine pain and/or more severely and/or debilitated patients may need 4 to 6 appointments to initiate and begin to reinforce an exercise program.

*Benefits* – Increased probability of engaging in an exercise program. Potential reinforcement with provider recommendations.

*Harms* – Medicalization, prolongation and increased risk of chronicity.

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

*Level of Confidence* – **Low**

## Evidence for the Use of Physical and Occupational Therapy

There are 13 moderate-quality RCTs incorporated into this analysis.(489, 499, 501, 565, 595, 854-861) There are 9 low-quality RCTs in Appendix 1.(495, 548, 579, 862-867)

*A comprehensive literature search was conducted using PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: physical therapy, occupational therapy, physiotherapy, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed, we found and reviewed 1,030 articles, and considered 25 for inclusion. In Scopus, we found and reviewed 2,759 articles, and considered two for inclusion. In CINAHL, we found and reviewed 94 articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed 21 articles, and considered zero for inclusion. We also considered for inclusion two articles from other sources. Of the 29 articles considered for inclusion, 22 randomized trials and 7 systematic studies met the inclusion criteria.*

## Devices

### Magnets And Magnetic Stimulation

Proponents believe that magnetic fields have therapeutic value in the treatment of musculoskeletal disorders. There are different levels of magnetic field therapies available with studies of 700 Gauss up to 4000 Gauss magnetic fields having been reported.

*Recommendation: Magnets and Magnetic Stimulation for Acute, Subacute, or Chronic Cervicothoracic Pain*

**Magnets are not recommended for the treatment of acute, subacute, or chronic cervicothoracic pain.**

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

*Level of Confidence* – **High**

### Rationale for Recommendation

While there are no high-quality sham controlled trials or trials comparing magnets to no treatment of cervical pain patients from which to draw robust conclusions, negative trials have been reported in the lumbar spine.(868, 869) Trials in the neck

have had methodological issues. There have been reports suggesting improvements attributed to higher magnetic fields in myofascial pain syndrome patients.(870, 871) However, these studies had differences in baseline characteristics that potentially result in difficulty drawing reliable conclusions. There are no reports of a therapeutic benefit of MRI testing, which exposes patients to very high magnetic fields. The use of magnetic therapy with lower Gauss measures has not been shown to provide any lasting improvement in cervical pain.(872, 873) A low-quality study reported some improvement in WAD (whiplash associated disorder) patients; however, there are considerable weaknesses in study design resulting in a low quality rating.(874) A moderate-quality crossover pilot study of low back pain also suggested no benefit,(868) (see Low Back Disorders and Chronic Pain guidelines) thus by analogy, it may be presumed that magnets are ineffective for treatment of cervical pain. Magnets are not invasive, have no adverse effects, and are low cost, but with negative results in the lumbar spine are not recommended.

## Evidence for the Use of Magnets and Magnetic Stimulation

There are 4 moderate-quality RCTs incorporated in this analysis.(870-873) There are 2 low-quality RCTs in Appendix 1.(874, 875)

*Magnets and magnetic stimulation – A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Magnets, magnetic stimulation, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. In PubMed we found and reviewed 760 articles, and considered 4 for inclusion. In Scopus, we found and reviewed 424 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 50 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 18 articles, and considered 2 for inclusion. We also considered for inclusion 3 articles from other sources. Of the 9 articles considered for inclusion, 4 randomized trials and 5 systematic studies met the inclusion criteria.*

## Iontophoresis

Iontophoresis is a drug delivery system utilizing electrical current to transdermally deliver either glucocorticosteroids or NSAIDs and that has apparent efficacy in the extremities where the dermis and adipose tissue overlying the target tissue is thin and penetration of the medicine to the target tissue is possible, which does not describe the spine.(876)

*Recommendation: Iontophoresis for Acute, Subacute, or Chronic Cervicothoracic Pain or Radicular Pain Syndromes or Other Back-related Conditions*

**Iontophoresis is not recommended for the treatment of acute, subacute, or chronic cervicothoracic pain or radicular pain syndromes or other back-related conditions.**

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

*Level of Confidence – Low*

## Rationale for Recommendation

There are no sham controlled or quality studies regarding the use of iontophoresis in cervicothoracic pain. Iontophoresis is not shown to be efficacious for the treatment of acute, subacute, or chronic cervicothoracic pain or radicular pain syndromes or other back-related problems. It is not invasive and is not low cost. There are other interventions shown to be efficacious.

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Iontophoresis, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. In PubMed we found and reviewed 751 articles, and considered 0 for inclusion. In Scopus, we found and reviewed 27 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 0 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 9 articles, and considered 0 for inclusion. We also considered for inclusion 1 article from other sources. Of the 1 article considered for inclusion, 0 randomized trials and 1 systematic study met the inclusion criteria.*

## Physical Methods

There are many modalities that have been used to treat cervicothoracic pain. This section includes detailed reviews of massage, reflexology, manipulation, traction, etc.

### Acupuncture

Acupuncture is based in part on the theory that many diseases are manifestations of an imbalance between yin and yang, as reflected by disruption of normal vital energy flow (qi) in specific locations, referred to as meridians. Needling along one of the 361 classical acupuncture points on these meridians is believed to restore balance. This stimulation is classically done with thin, solid, metallic needles, which are frequently manipulated (or turned) manually or stimulated electrically (electroacupuncture). In addition to needling, acupuncture frequently involves moxibustion and cupping. Besides traditional Chinese acupuncture, there are many other types of acupuncture that have arisen, including accessing non-traditional acupuncture points.(544, 554, 877-880)

#### 1. Recommendation: Acupuncture for Chronic Cervicothoracic Pain

**Acupuncture is recommended for select use in chronic cervicothoracic pain with or without radicular symptoms as an adjunct to facilitate more effective treatments.**

*Indications* – As an adjunct treatment option for chronic cervicothoracic pain as a limited course during which time there are clear objective and functional goals that are to be achieved. Considerations include time-limited use in chronic cervicothoracic pain patients without underlying serious pathology as an adjunct to a conditioning program that has both graded aerobic exercise and strengthening exercises. Acupuncture is recommended to assist in increasing functional activity levels more rapidly, and, if it is recommended, the primary attention should remain on the conditioning program. In those not involved in a conditioning program, or who are non-compliant with graded increases in activity levels, this intervention is not recommended.

*Frequency/Duration* – Different frequencies and numbers of treatments used in quality studies ranged from weekly for 1 month to 20 appointments over 3 months. Usual program is 10 sessions over 3 to 4 weeks.(881) An initial trial of 5 to 6 appointments is recommended in combination with a conditioning program of aerobic and strengthening exercises. Future appointments should be tied to improvements in objective measures to justify an additional 6 sessions, for a total of 12 sessions.

*Indications for Discontinuation* – Resolution, intolerance, or non-compliance including non-compliance with aerobic and strengthening exercises.

*Harms* – Rare needling of deep tissue, such as artery, lung, etc. and resultant complications. Use of acupuncture may theoretically increase reliance on passive modality(ies) for chronic pain.

*Benefits* – Modest reduction in pain.

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

*Level of Confidence* – **Low**

#### 2. Recommendation: Acupuncture for Acute or Subacute Cervicothoracic Pain

**Routine use of acupuncture is not recommended for treatment of acute or subacute cervicothoracic pain or for acute radicular pain.**

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

*Level of Confidence* – **Low**

### Rationale for Recommendations

There are quality studies evaluating the utility of acupuncture for treatment of chronic cervicothoracic pain, although they conflict to some extent regarding whether it is efficacious and which type of acupuncture to perform. (679, 882-884) One issue is the benefit of acupuncture versus electroacupuncture. A moderate-quality study showed that electroacupuncture was more effective than acupuncture alone.(885) Quality trials compared to sham demonstrated a short term improvement in range of motion and pain(882, 883, 886) and one of these moderate quality trials showed acupuncture was associated with improvements in pain-related activity, sleep, anxiety, depression, and satisfaction with life.(881) Trials comparing acupuncture with no treatment have shown a decrease in pain of up to 40% over baseline after 12 weeks.(887) The highest scored study (see evidence table) showed improvement in motion-related pain 1 hour after acupuncture above that seen for dry needling and sham acupuncture.(882) Benefits beyond the duration of treatment of up to 3 years have been suggested.(881) However, studies generally fail to control for attention bias, and also suggest that needling in locations other

than traditional acupuncture points can provide equal benefit,(881, 888, 889) which leads to questions regarding whether it is the needling rather than the acupuncture that was beneficial. Other quality trials have compared acupuncture with physiotherapy and medications and other treatments, with some failing to find differences in outcomes. A moderate-quality study of acupoint electrical stimulation did not find improvement in patients with variable duration of pain ranging from acute to chronic.(890) Other studies found less of an effect or no effect, when compared to other treatments and placebo.(679, 886, 891) One moderate-quality study looked at acupuncture compared to sham acupuncture; both treatment groups improved without a significant difference between the two up to 16 weeks after intervention.(884)

There is no high quality evidence for treatment of acute cervicothoracic pain, radicular pain syndromes, or other cervical pain-related conditions. Acupuncture would not be expected to improve on the history of acute cervicothoracic pain treated with more effective treatments reviewed elsewhere.

Despite reservations regarding its true mechanism of action, the overall presence of quality trials demonstrating superiority of acupuncture to sham acupuncture provides quality evidence of efficacy, although the magnitude of benefits is modest and the treatment is passive. Acupuncture is minimally invasive, has relatively low adverse effects in experienced hands, and is moderate cost depending on numbers of treatments.

## Evidence for the Use of Acupuncture

There are 5 high-(679, 882-885) and 42 moderate-quality (568, 585, 675, 681, 848, 862, 881, 886-920) RCTs or crossover trials incorporated into this analysis. There are 5 low-quality RCTs in Appendix 1.(677, 921-924)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: acupuncture, acupotomy, electroacupuncture, acupressure, acupuncture therapy, warm needling, dry needling, needling, de-qi, warm, dry, pressure, electric current, needle, pressure needling, cervicgia, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular, pain, intervertebral disc displacement, herniated, herniat\*, displacement, displaced, disc, disk, discs, disks, neck pain, radicular pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review. In PubMed we found and reviewed 223 articles, and considered 49 for inclusion. In Scopus, we found and reviewed 42 articles, and considered 8 for inclusion. In CINAHL, we found and reviewed 8 articles, and considered 2 for inclusion. In Cochrane Library, we found and reviewed 14 articles, and considered 1 for inclusion. We also considered for inclusion 17 articles from other sources. Of the 77 articles considered for inclusion, 51 randomized trials and 21 systematic studies met the inclusion criteria.*

## Cryotherapies

Cold or cryotherapies involve applications of cold or cooling devices to the skin, such as towels moistened with cold water, ice wrapped in a blanket, ice massage, cold water and/or ice placed in a “water bottle,” gel packs, cooling sprays, or single-use chemical packets that produce cooling on breaking one pouch inside the other to start a chemical reaction.

Cryotherapy is theorized to result in a delay or reduction of inflammation.(925) Application of cold will result in vasoconstriction, though a subsequent vasodilatory response to reassert homeostasis is also likely. Similar to heat therapies, most researchers believe that cryotherapies do not directly result in healing. Rather, the general beliefs are that these thermal treatments affect only the skin and subcutaneous fat and yet skin stimulation may distract the patient from other painful stimuli, thus allowing faster resumption of normal activities or increased tolerance of therapeutic exercises. Despite lacking evidence of direct healing benefits, the potential for increased function and earlier recovery may still be worth utilizing cryotherapies for the patient’s benefit, particularly as the cost for some of these methods is minimal.

### 1. Recommendation: Cryotherapies for Management of Acute Cervicothoracic Pain

**Self applications of low-tech cryotherapies are recommended for management of acute cervicothoracic pain.**

Cryotherapies may be tried for other forms of cervicothoracic pain, though they may be less beneficial.

*Indications* – Moderate to severe acute cervicothoracic pain patients with sufficient symptoms that an NSAID/acetaminophen and progressive graded activity are believed to be insufficient. May be tried as well for subacute or chronic pain, but suggested threshold for discontinuation is lower, particularly as active modalities are generally far preferable to passive modalities for rehabilitation of non-acute cervicothoracic pain.

*Frequency/Duration* – It is recommended that the therapy be for 15 minutes or less to avoid damage to tissue. It may be repeated as often as every 30 minutes.



*Indications for Discontinuation* – Non-tolerance, including exacerbation of cervicothoracic pain.

*Benefits* – Potential modest reduction in spine pain. Self-efficacy, although relying on a passive modality.

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

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

*Level of Confidence* – **Low**

2. *Recommendation: Routine Use of Cryotherapies in Health Care Provider Offices or Home Use of High-tech Devices*

**Routine use of cryotherapies in health care provider offices or home use of a high-tech device for the treatment of cervicothoracic pain is not recommended.** However, single use of low-tech cryotherapy (ice in a plastic bag) for severe exacerbations is reasonable.

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

*Level of Confidence* – **Moderate**

## Rationale for Recommendations

Self-application of cryotherapies using towels or reusable devices is not invasive, is without complications, and does not have any appreciable costs. These are recommended as potential distractants or counter-irritants. Other forms of cryotherapy can be considerably more expensive, including chemicals or cryotherapeutic applications in clinical settings, and are not recommended.

## Evidence for the Use of Cryotherapies

There is 1 moderate-quality RCT incorporated into this analysis.(926) There is 1 low-quality RCT in Appendix 1.(927)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: cryotherapy, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 18 articles, and considered two for inclusion. In Scopus, we found and reviewed 40 articles, and considered one for inclusion. In CINAHL, we found and reviewed two articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed 2 articles, and considered one for inclusion. We also considered for inclusion one article from other sources. Of the 5 articles considered for inclusion, 2 randomized trials and 3 systematic studies met the inclusion criteria.*

## Heat Therapies

There are many forms of heat therapy for treatment of cervicothoracic pain. These include hot packs, moist hot packs, sauna, warm baths, infrared, diathermy, and ultrasound.(928) The depth of penetration of heat is minimal for local convective means, but the other modalities have deeper penetration.(929) Unlike in the lower spine, there are few studies that look specifically at using heat therapy. They include heat therapies often as a part of a treatment protocol.

## Hot Packs, Heat Wraps, and Moist Heat

The application of warmth or heat is frequently divided into dry or moist heat. Moist heat involves the application of a wet towel or other device that brings the warmed water into direct contact with the skin. Dry heat does not involve direct application of water on the skin surface. In the simplest form, a heated towel is used. Heat wraps include devices that produce heat at greater depth than typical convective heat.(930, 931) Moist heat most commonly involves heating wet towels, soaking a towel in warm water, or using commercial products that are soaked in a warm bath prior to application on the skin surface.(928, 932)

*Recommendation: Heat Therapy for Acute, Subacute, or Chronic Cervicothoracic Pain*

**Heat therapy, including a heat wrap, is recommended for treatment of acute, subacute, or chronic cervicothoracic pain.**

However, use in chronic cervicothoracic pain is recommended to be minimized to flare-ups with the primary emphasis in chronic cervicothoracic pain patients being placed on functional restoration elements including aerobic and strengthening exercises. **Self-application of heat is recommended.**

*Indications* – Self-applications may be periodic or continuous. These applications should be home-based as there is no evidence for particular efficacy of provider based heat treatments.

*Frequency/Duration* – Self-applications may be periodic and include different regimens – e.g., 15 to 20 minutes, 3 to 5 times a day.(932)

*Indications for Discontinuation* – Intolerance, increased pain, or development of a burn or other adverse event.

*Benefits* – Potential modest reduction in spine pain. Self-efficacy, although relying on a passive modality.

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

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

*Level of Confidence* – **Low**

2. *Recommendation: Application of Heat Therapy by a Health Care Provider for Chronic Spine Pain*

**Application of heat (such as infrared, moist heat, whirlpool) by a health care provider is not recommended for chronic spine pain as the patient can perform this application independently.**

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

*Level of Confidence* – **Moderate**

## Rationale for Recommendation

A moderate-quality trial compared manipulation and mobilization with and without moist heat therapy. The authors reported that a clinically meaningful reduction in most severe pain was 60% more likely among participants assigned to heat therapy vs no heat at the 2 week follow-up assessment.(932) Heat therapy in the form of a commercial heat wrap has not been studied as well in cervical pain as in lumbar pain. While there is a lack of direct RCTs evaluating heat, with the evidence that is available in cervicothoracic pain, it is reasonable to prescribe. It is most beneficial to use heat in conjunction with a treatment program that is active.(932)

## Evidence for the Use of Heat Therapy

There are 3 moderate-quality RCTs incorporated into this analysis.(926, 928, 932)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Heat therapy (including heat wrap), Hot Packs, Heat Wraps, and Moist Heat, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. In PubMed we found and reviewed 718 articles, and considered 2 for inclusion. In Scopus, we found and reviewed 944 articles, and considered 1 for inclusion. In CINAHL, we found and reviewed 40 articles, and considered 1 for inclusion. In Cochrane Library, we found and reviewed 22 articles, and considered 0 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 3 articles considered for inclusion, 3 randomized trials and 0 systematic studies met the inclusion criteria.*

## Diathermy

Diathermy is a type of heat treatment that has been used clinically to heat tissue.(558, 933) There are two forms of diathermy – short wave and microwave. High-dose diathermy is also used to coagulate tissue. Proponents of diathermy utilize it to treat a wide range of conditions; they believe it penetrates deeper than hot packs or heating pads and stimulates healing.(933, 934)

*Recommendation: Diathermy for Cervicothoracic Pain*

**Diathermy is not recommended for treatment of any cervicothoracic pain-related condition.**

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

*Level of Confidence* – **Moderate**

### RATIONALE FOR RECOMMENDATION

There are no sham-controlled studies evaluating diathermy in cervicothoracic pain. A moderate-quality trial evaluated diathermy with advice and exercise, compared to advice and exercise alone and did not find any benefit at 6 month follow

up.(558) Diathermy is moderate cost, not invasive, and has low potential for adverse effects as typically utilized. It is more expensive than other alternatives such as heat and moderate quality evidence suggests it is ineffective.

#### **EVIDENCE FOR THE USE OF DIATHERMY**

There is 1 high-(935) and 2 moderate-quality RCTs (one with two reports)(558, 578, 579) incorporated into this analysis.

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: diathermy, diathermies, dielectric heating, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 51 articles, and considered 3 for inclusion. In Scopus, we found and reviewed 53 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 1 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 1 articles, and considered 0 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 3 articles considered for inclusion, 3 randomized trials and 0 systematic studies met the inclusion criteria.*

## **Infrared Therapy**

Infrared is a heat treatment created by various devices producing electromagnetic radiation in the infrared spectrum.(575, 936)

*Recommendation: Infrared Therapy for Acute, Subacute, Chronic, or Radicular Cervicothoracic Pain*

**There is no recommendation for or against the use of infrared therapy for treatment of acute, subacute, chronic, or radicular cervicothoracic pain.**

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

*Level of Confidence – Low*

#### **RATIONALE FOR RECOMMENDATIONS**

There are no quality sham-controlled trials of infrared therapy in cervicothoracic pain patients. A moderate-quality trial compared TENS plus infrared therapy, exercise plus infrared therapy, and infrared therapy in patients with >3 months of intermittent cervicothoracic pain.(575) Since infrared therapy was used in all treatment groups, no conclusion about its effectiveness is possible. The authors reported improvement in muscle strength, improvement in the Northwick Park Neck Pain Questionnaire, but no improvement in verbal numerical pain scale, medication use, or number of subjects taking sick leave because of neck pain at 6 weeks in the infrared therapy only group. The improvement in the Northwick Park Neck Pain Questionnaire was maintained in the infrared therapy only group at 6 months.(575) Infrared is moderate cost, not invasive, and has little potential for adverse effects. It is more expensive than other alternatives such as heat and has not been shown to be superior to less expensive forms of heat therapy. There is no evidence to suggest it is effective and thus there is no recommendation.

#### **EVIDENCE FOR THE USE OF INFRARED THERAPY**

There are 2 moderate-quality RCTs incorporated into this analysis.(575, 598)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: infrared therapy, infrared rays, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 33 articles, and considered 1 for inclusion. In Scopus, we found and reviewed 49 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 2 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 1 articles, and considered 1 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 3 articles considered for inclusion, 2 randomized trials and 1 systematic studies met the inclusion criteria.*

## **Ultrasound (Therapeutic)**

Ultrasound consists of sound waves that are absorbed differently based on the protein content of the tissue. Proponents states this allows heating of deep tissues such as joints, muscle and bone and this leads to repair of soft tissue injuries and is a

way to relieve pain.(937) The head of the ultrasound instrument should be kept in constant motion to minimize discomfort and prevent tissue damage. Therapeutic ultrasound has more than 60 years of clinical history.(937) It has been frequently used for the treatment of pain, soft-tissue lesions, and a host of musculoskeletal disorders.

*Recommendation: Ultrasound for Acute, Subacute, or Chronic Cervicothoracic Pain*

**There is no recommendation for or against the use of ultrasound for treatment of acute, subacute, or chronic cervicothoracic pain. In situations where deeper heating is desirable, a limited trial of ultrasound is reasonable for treatment of acute cervicothoracic pain, but only if performed as an adjunct with exercise.**

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

*Level of Confidence – Low*

#### **RATIONALE FOR RECOMMENDATION**

There are no quality trials of ultrasound for the treatment of cervicothoracic pain. There is a low-quality trial comparing manipulation to ultrasound therapy in conjunction with NSAIDs and neck collar that was conducted in acute whiplash patients. Improvements in both groups in range of motion, pain, and disability rankings were reported.(938) Ultrasound is not invasive, has few adverse effects, but is moderately costly. There is no recommendation for or against its use in treatment of cervicothoracic pain.

#### **EVIDENCE FOR THE USE OF ULTRASOUND**

There are no quality trials of ultrasound for the treatment of cervicothoracic pain. There is 1 moderate-quality RCT for myofascial trigger points incorporated into this analysis.(939) There are 2 low-quality RCTs in Appendix 1.(938, 940)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: ultrasound, ultrasound therapy, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. In PubMed we found and reviewed 718 articles, and considered 53 for inclusion. In Scopus, we found and reviewed 4 articles, and considered 6 for inclusion. In CINAHL, we found and reviewed 40 articles, and considered 1 for inclusion. In Cochrane Library, we found and reviewed 22 articles, and considered 0 for inclusion. We also considered for inclusion 15 articles from other sources. Of the 2 articles considered for inclusion, 1 randomized trials and 1 systematic studies met the inclusion criteria.*

## **Low-Level Laser Therapy**

Low-level laser treatment usually involves laser energy that does not induce significant heating (see Myofascial Pain Syndrome in Shoulder Disorders guideline for additional recommendation).(941-945)

*Recommendation: Low-level Laser Therapy for Acute, Subacute, or Chronic Cervicothoracic Pain*

**There is no recommendation for or against the use of low-level laser therapy for the treatment of acute, subacute, or chronic cervicothoracic pain.**

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

*Level of Confidence – Low*

#### **RATIONALE FOR RECOMMENDATION**

There are trials of LLLT for the treatment of cervicothoracic pain, however, there are methodological issues with nearly all available studies and the studies somewhat conflict. More sham-controlled trials suggest benefit than those that do not. Quality trials, including assessing adequacy of blinding, are needed prior to a recommendation.

#### **EVIDENCE FOR THE USE OF LOW-LEVEL LASER THERAPY**

There are 2 high-(944, 946) and 4 moderate-quality RCTs(939, 942, 945, 947) incorporated into this analysis.

We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:

Neck Pain, Cervicalgia, Cervical Pain, Cervical Radiculopathy, Radicular Pain, Postoperative neck Pain, Postoperative cervical Pain, Herniated Disk, neck pain, cervical pain, cervical radiculopathy, radicular pain, herniated disk, postoperative neck pain, postoperative cervical pain, laser therapy, low-level, Low level laser therapy, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies;  
to find 408 articles. Of the 408 articles, we reviewed 14 articles and included 12 articles (6 randomized controlled trials and 6 systematic reviews).

## Manipulation And Mobilization

Manipulation and mobilization are two types of manual therapy. These include wide arrays of different techniques and schools of thought. Some consider these two interventions to be on a spectrum of velocity and applied force. In general, mobilization involves assisted, low-force, low-velocity movement within or at the limit of joint range of motion. Manipulation involves higher-force, higher-velocity, and low-amplitude action with a focus on moving a target joint.

From the standpoint of evidence-based practice guidelines development, there are numerous types of manipulation utilized in many different studies.(562, 675, 897, 948-953) These issues result in difficulties comparing methods, techniques, or results across the available literature. Differences between techniques appear to be largely unstated in the available systematic reviews, which have aggregated all studies together. Adjustment is generally a synonym for manipulation in the chiropractic profession. There are studies evaluating thoracic manipulation for cervical pain without cervical manipulation.(954)

Many practitioners begin with lower force manipulation or mobilization techniques, and reserve higher force manipulation techniques for those who do not respond to lower force techniques to limit adverse effects and complications. Manipulation is generally considered a safe procedure, but like all other treatments is not without risks. For example, reported fatal outcomes have occurred and are particularly attributed to cervical manipulation.(932) Reports of more severe but rare adverse effects include vertebrobasilar dissection, carotid artery injury, and disc herniation or spinal cord compression myelopathy, although these reports need to be considered in the context of natural progressions of cervical pain without any intervention.(955) The mean age of patients experiencing vertebrobasilar dissection in the case reports is 38 and the risk has been reportedly due to cervical manipulation with a rotary component.(932) However, more recent population based studies have questioned the incidence of vascular injury from manipulation, suggesting instead that this may more often be an acceleration or natural progression of an event in progress.(956) Mobilization is less likely to lead to side effects than is manipulation.

The most common adverse response to neck manipulation is local discomfort that resolves within 24 to 48 hours.(932) (Hurwitz AJPH 02)There have been reports of vertebral artery dissection that result in posterior circulation stroke purportedly following cervical manipulation.(948) There has been much debate on the frequency of these events and multiple reports suggest low risk.(957) Population-based case control study of all patients who seek chiropractic care in Ontario revealed a frequency of 8 cases occurred within 7 days of receiving chiropractic care in 109 million person years of observation in Ontario.(956) Of particular interest was the observation that the odds ratio of a stroke occurring after a primary physician visit for cervical pain was the same as that noted following a chiropractic office visits, raising doubt as to whether there is any relationship between the manipulation and stroke. Vertebral artery dissections are heralded by cervical pain and frequently headache that can bring a patient to either a chiropractor or general physician's office, and if not recognized can progress to stroke that can be fatal. This should be considered in the differential diagnosis of cervical pain.

### 1. Recommendation: Manipulation/Mobilization for Acute, Subacute, or Chronic Cervicothoracic Pain

**Manipulation/mobilization of the cervical and/or thoracic spine is recommended for short-term relief of cervical pain or as a component of an active treatment program focusing on active exercises for acute cervicothoracic pain.**

However, high amplitude, high velocity manipulation is not recommended.

*Frequency/Duration* – Dependent on severity. Most patients with more severe spine conditions may receive up to 12 visits over 6 to 8 weeks, typically one to 3 times a week;(958-960) total treatments dependent on response to therapy.

Substantial progression (e.g., return to work or activities, increasing ability to tolerate exercise, reduced medication use)

should be documented at each follow-up visit. Treatment plan should be reassessed after each 2-week interval. Most guidelines suggest that if there is significant response in the above outcomes, it is worth considering another 2 weeks of treatment. If no response to 2 weeks of application of a particular manipulation treatment, it should be discontinued and 2 weeks of a different method of manipulation/mobilization or other treatment should be considered. If there is no response after 4 weeks and two 2-week trials of different manipulation/mobilization techniques, it is unlikely that further manipulation/mobilization will be helpful.

*Indications for Discontinuation* – Lack of demonstrated continued functional response after 6 manipulation/mobilization sessions (2 trials of 2 or more different methods), resolution of symptoms, or failure to participate in an active rehabilitation program.

*Benefits* – Potential for faster resolution of pain and improved function.

*Harms* – Worsening of neck pain, especially immediately after manipulation.

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

*Level of Confidence* – **Low**

## Rationale for Recommendation

Multiple studies evaluate thoracic and cervical spine manipulation, (537, 932) whereas other studies evaluated one or the other.(949, 959, 961-964) Other studies do not delineate between the two different types of therapies.(578, 579, 675, 679, 965, 966)

There are no quality trials comparing mobilization to sham or placebo for treatment of acute cervical pain. The closest study appears to be that of Cleland et al (2007), but it was impaired by methodological limitations. Most studies compare mobilization to manipulation, or use mobilization as a component of other interventions, significantly weakening the ability to infer efficacy of manipulation.(581) Most studies had small samples sizes with most <70.(959, 960, 967, 968) A moderate-quality trial evaluating mobilization suggested greater benefit compared with directed exercise and continued care by a general practitioner. However, this study included acute, subacute, and chronic pain without delineation between duration in the results, and the general practitioner care appeared to fail to include treatments thought to be efficacious.(565) A moderate-quality trial comparing cervical manipulation to mobilization suggested improvement in pain and range of motion in both groups after a single treatment, but manipulation was reportedly associated with overall better pain improvement on the NRS-101 and larger gains in range of motion.(6) Thus, the available quality evidence conflicts on treatment of cervicothoracic pain.(969) Hoiving suggested mobilization is a favorable treatment option for patients with cervical pain compared with directed exercise or continued care by a general practitioner, although the general medical care may have been suboptimal.(565)

There are no sham-controlled trials of manipulation. Only a few RCTs evaluated subacute cervicothoracic pain and did so in combination with chronic cervicothoracic pain without reporting findings based on duration of symptoms. (960) A moderate-quality study comparing a single episode of cervical manipulation versus mobilization in subacute and chronic patients reported manipulation to have greater improvement in cervicothoracic pain at rest and active range of motion.(961) A moderate-quality study that did not describe well the duration of symptoms found an increase in range of motion after a single thoracic spine manipulation compared to no intervention.(970) (Krauss 08) Where another study compared manipulation and exercises alone and in combination and reported no significant clinical differences at 12-month follow up in chronic pain patients.(537)

A moderate-quality study of patients with chronic pain examined manipulation, manipulation and exercise and an exercise only group. They found that the manipulation alone group had less improvement compared to manipulation with exercise and exercises alone at 16 months after 11 weeks of treatment.(537) One study of 119 patients with cervicothoracic pain greater than 3 months duration reported improvement in all groups, but did not find any difference in the manipulation group when compared to physiotherapy and intensive training of cervical musculature for 6 weeks.(548) A moderate-quality study suggested acupuncture was more effective than manipulation or medications in treating chronic cervical pain.(675) Another moderate-quality study compared manipulation with sham ultrasound to sham ultrasound alone and suggested an improvement in pain in the manipulation group at 12 weeks.(971) While the RCTs show that other interventions are equally beneficial, the manipulation groups also experienced significant improvement in pain control and range of motion. Manipulation in subacute and chronic cervicothoracic pain is recommended and is best utilized in combination with an active exercise program.(537, 972) It was not possible to determine which technique was beneficial for which patient populations. There was also insufficient evidence for cervicothoracic pain with radicular findings.

A study evaluated a Clinical Prediction Rule for cervicothoracic pain using thoracic manipulation that is somewhat analogous to those for the lumbar spine (see Low Back Disorders guideline). They reported predictors for increasing the likelihood of a positive outcome with thoracic manipulation.(973, 974) These 6 variables were symptoms <30 days, no symptoms distal to the shoulder, neck extension does not aggravate pain, FABQPA score <12, diminished upper thoracic spine kyphosis, and cervical extension ROM <30 degrees. Once this information has been reproduced and validated there may be a group of patients identified where thoracic manipulation may be recommended with greater specificity. However, a recent RCT reported that the above CPR was not able to be validated.(975) Another group assessed a clinical prediction rule and noted better response to treatment if: initial Neck Disability Index <11.5, bilateral involvement pattern, no sedentary work >5 hours a day, feeling better while moving the neck, not worse while extending the neck, and a diagnosis of spondylosis without radiculopathy.(976)

#### *2. Recommendation: Manipulation for Chronic Cervicogenic Headache Pain*

**Spinal manipulation of the cervical and/or thoracic spine is recommended for treatment of chronic cervicogenic headache pain.**

*Frequency/Duration* – Once or twice a week for 4 to 5 appointments, up to 8 total appointments recommended if there is benefit after 4 to 5 appointments.(599, 977)

*Indications for Discontinuation* – Resolution of symptoms, adverse effects from treatment, lack of demonstrated positive effect on headache intensity and/or frequency, or non-participation in an active rehabilitation therapy program.(978)

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

*Level of Confidence* – **Low**

#### *3. Recommendation: Manipulation for Chronic Cervicogenic Headache Pain*

**High-amplitude, high-velocity spinal manipulation of the cervical and/or thoracic spine is not recommended for treatment of cervical spine conditions.**

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

*Level of Confidence* – **Low**

### **Rationale for Recommendation**

A moderate-quality study evaluated 80 patients with chronic cervicogenic headache randomized to either 8 or 16 spinal manipulation sessions in 8 weeks as the intervention group, and 8 or 16 sessions of “light massage” as the control group. The authors reported both clinical and statistical benefit of manipulation lasting up to 24 weeks with decreased reported pain and decreased reported analgesic use. There was no clear benefit of 16 versus 8 visits.(977) A moderate-quality study evaluated cervical manipulation with sham manipulation in a modified crossover study design suggested improvement with cervical range of motion, but did not find improvement in headache pain.(979) Another moderate-quality study in headache patients evaluated cervical manipulation compared to low level laser treatment and massage and failed to find a difference in cervical range of motion, analgesic use per day, headache intensity per episode and number of headaches per day.(978, 980) A moderate-quality study that was a continuation of an earlier study evaluated high velocity low amplitude manipulation with laser and massage as placebo. They reported significant improvement in cervicogenic headache.(981) A moderate-quality study evaluated manipulation versus exercise and found that exercise groups produced better long term outcomes than placebo or manipulation alone.(599) High-amplitude, high-velocity manipulation is not recommended due to concerns it may increase risk of adverse effects such as arterial dissection.

#### *4. Recommendation: Cervical Manipulation for Tension Headaches*

**Cervical manipulation is not recommended for tension headaches.(982-984)**

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

*Level of Confidence* – **Low**

### **Rationale for Recommendation**

There is a moderate-quality study of 75 patients evaluating cervical manipulation versus laser light therapy and soft tissue massage as placebo. The authors did not find any benefit of manipulation after 19 weeks of follow up.(983) Another moderate-quality study evaluated manipulation compared to amitriptyline for tension headaches. They found after discontinuation of treatment, manipulation had positive outcomes over amitriptyline; however, they did not address possible withdrawal headaches from amitriptyline.(984)

5. *Recommendation: Regular or Routine Manipulation or Mobilization*  
**Regular or routine manipulation or mobilization, prolonged treatment (manipulation several times a month for years), and prophylactic treatment is not recommended.**  
*Strength of Evidence – Not Recommended, Insufficient Evidence (I)*  
*Level of Confidence – High*

### Rationale for Recommendation

There is no quality evidence of efficacy for prolonged treatment (manipulation several times a month for years). There is no quality evidence that prophylactic treatment is effective for primary prevention (before first episode of pain) or for secondary prevention (after recovery from an episode of cervicothoracic pain), and prophylactic treatment is not recommended. There is also no evidence that manipulation on a regular or routine basis is beneficial.

6. *Recommendation: Manipulation for Radicular Pain Syndromes with Acute Neurological Deficits*  
**Manipulation is not recommended for the treatment of radicular pain syndromes with acute neurological deficits, especially with progressive neurological loss.**  
*Strength of Evidence – Not Recommended, Insufficient Evidence (I)*  
*Level of Confidence – Moderate*
7. *Recommendation: Manipulation for Radicular Pain Syndromes without Neurologic Deficits*  
**There is no recommendation for or against manipulation for the treatment of radicular pain syndromes without neurologic deficits.**  
*Strength of Evidence – No Recommendation, Insufficient Evidence (I)*  
*Level of Confidence – Low*

### Rationale for Recommendations

There is no quality evidence to address manipulation with neurological deficits; however, there are concerns about the use of manipulation in the presence of acute or progressive neurological deficits. Young et al. conducted an RCT evaluating cervical traction for radicular pain. Each group received manual therapy consisting of HLVA of the cervical and thoracic spine in addition to exercise. They reported improvement in both groups; however the study was not designed to evaluate the effects of manipulation of cervical radiculopathy.(562) Another study compared cervical lateral glide mobilization to ultrasound and reported benefits for manipulation. The evaluations were taken immediately following the single intervention without long-term follow up.(985)

### Evidence for the Use of Manipulation and Mobilization

There are 4 high-(562, 679, 986, 987) and 76 moderate-quality RCTs or crossover trials (one with two reports) incorporated into this analysis.(6, 222, 497, 536, 537, 544, 548, 565, 567, 573, 574, 576, 578, 579, 581, 584, 675, 676, 897, 932, 949, 950, 958, 959, 961-963, 965-971, 977-979, 981-985, 988-1021) There are 25 low-quality (617, 867, 1022-1046) RCTs and 5 other studies (964, 1044, 1046-1048) in Appendix 1.

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: manipulation and mobilization, disorder terms-cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Non-experimental Studies. In PubMed we found and reviewed 756 articles, and considered 130 for inclusion. In Scopus, we found and reviewed 1,436 articles, and considered 5 for inclusion. In CINAHL, we found and reviewed 134 articles, and considered 8 for inclusion. In Cochrane Library, we found and reviewed 32 articles, and considered 0 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 143 articles considered for inclusion, 104 randomized trials and 13 systematic studies met the inclusion criteria.*



## Manipulation Under Anesthesia (MUA) And Medication-Assisted Spinal Manipulation (MASM)

Manipulation under anesthesia (MUA) and medication-assisted spinal manipulation (MASM) involves the administration of anesthesia or medication followed by manipulation of the spine with the intended effect of relieving cervicothoracic pain. Proponents believe this method of manipulation is superior to manipulation without anesthesia due to factors including the reduction in resistance to movement that occurs after the administration of the anesthetic. However, such reductions in resistance may increase the likelihood of injuries to the patient.

*Recommendation: MUA and MASM for Acute, Subacute, or Chronic Cervicothoracic Pain*

**MUA and MASM are not recommended for the treatment of acute, subacute, or chronic cervicothoracic pain.**

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

*Level of Confidence – Moderate*

### Rationale for Recommendation

MUA and MASM have not been evaluated in chronic cervicothoracic pain patients, except in one study that used diazepam for its amnestic properties in blinding. However, that study concluded that after a single manipulation there was no benefit compared to no manipulation.(966) MUA/MASM is high cost, is invasive, and has increased potential for significant adverse effects. There are no specific contraindications to MUA beyond those of its individual components (e.g. anesthesia and SMT).(1049) These contraindications include spinal malignancy, hypermobility, instability, acute inflammation, infection, fracture, progressive neurological deficits, large aortic aneurysms, bleeding disorders, severe osteoporosis, acute gout, spinal cord compression, several canal stenosis, sequestered nucleus pulposus, or cardiopulmonary conditions precluding anesthesia.(1050) It has also been suggested that procedures such as MUA are not appropriate for patients who could improve with a simpler, more cost effective therapy that does not involve anesthesia.(1051) Judging from participant exclusion criteria used in previous studies on MAM, it would appear that patients with non-mechanical CLBP, active rheumatoid disease, tobacco use, severe coexisting disease, severe obesity, and involvement in workers' compensation or litigation are less likely to respond favorably to MUA, MUJA, or MUESI.(1049) Older forms of MUA as practiced many decades ago using more forceful long-lever techniques were associated with adverse events such as cauda equina syndrome, paralysis, and fracture.(1049) However, more recent studies evaluating newer, gentler techniques of MUA have not reported any serious adverse events.(1049) Temporary flare-ups in lumbosacral pain have been reported and are attributed to the stretching of adhesions and mobilization of inflamed joints achieved by MUA; such flare-ups are easily treated with postoperative care.(1052) A review of the MAM literature reported a total of 11 adverse events in 17 studies with a total of 1,525 participants (prevalence <1%).(1049) These adverse events included 8 cases of increased lumbosacral pain, one case of myelographic evidence of herniated intervertebral disc, and 2 cases of respiratory distress that resolved with Valium.(1049) An additional review of MUA reported no adverse events in any of the published studies, indicating they are likely rare.(1050) Most observational studies have reported no adverse events from MUA.(1049, 1053-1056)

### Evidence for the Use of MUA and MASM

There is 1 moderate-quality RCTs incorporated into this analysis.(966)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Manipulation under anesthesia, MUA, medication-assisted spinal manipulation, MASM, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 626 articles, and considered zero for inclusion. In Scopus, we found and reviewed 76 articles, and considered zero for inclusion. In CINAHL, we found and reviewed zero articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed zero articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the one article considered for inclusion, zero randomized trials and zero systematic studies met the inclusion criteria.*

## Massage

Massage is a commonly used treatment for cervicothoracic pain and is administered by multiple health care providers, as well as family or friends. Massage is theorized to aid muscle and mental relaxation and to result in increased pain tolerance through endorphin release.(1057) Other theories are that massage may enhance local blood flow and could increase clearance of chemical pain mediators or stimulate large diameter nerve fibers that have an inhibitory input on T-cells in the spinal cord, resulting in decreased pain.(1058) A complicating factor in this review is the varying methods of massage that are employed.(1059, 1060)

### 1. *Recommendation: Massage for Chronic Cervicothoracic Pain*

**Massage is recommended for select use in chronic cervicothoracic pain as an adjunct to more efficacious treatments consisting primarily of a graded aerobic and strengthening exercise program.**

*Indications* – For time-limited use in chronic cervicothoracic pain patients without underlying serious pathology as an adjunct to a conditioning program that has both graded aerobic exercise and strengthening exercises. The intervention is only recommended to assist in increasing functional activity levels more rapidly and the primary attention should remain on the conditioning program. In patients not involved in a conditioning program or who are non-compliant with graded increases in activity levels, this intervention is not recommended.

*Frequency/Duration* – Six to 10 sessions of 30 to 35 minutes each, 1 or 2 times a week for 4 to 6 weeks.(1061) Objective improvements should be shown approximately half way through the regimen to continue this treatment course.

*Indications for Discontinuation* – Resolution, intolerance, lack of benefit, or non-compliance with aerobic and strengthening exercises.

*Benefits* – Modest reduction in pain.

*Harms* – Short term discomfort during massage, and potentially longer term afterwards with more vigorous massage.

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

*Level of Confidence* – **Low**

### 2. *Recommendation: Massage for Acute and Subacute Cervicothoracic Pain and Chronic Radicular Syndromes*

**Massage is recommended as a treatment for acute and subacute cervicothoracic pain and chronic radicular syndromes in which cervicothoracic pain is a substantial symptom component.**

*Indications* – Patients with subacute and chronic cervicothoracic pain without underlying serious pathology, such as fracture, tumor, or infection.

*Frequency/Duration* – Objective benefit (functional improvement along with symptom reduction) may be demonstrated after a trial of 2 sessions in order for further treatment to continue, for up to 10 sessions during which a transition to a conditioning program is accomplished.

*Indications for Discontinuation* – Resolution, intolerance, or lack of benefit.

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

*Level of Confidence* – **Low**

### 3. *Recommendation: Mechanical Devices for Administering Massage for Cervicothoracic Pain*

**Mechanical devices for administering massage are not recommended for cervicothoracic pain.**

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

*Level of Confidence* – **Low**

## Rationale for Recommendations

There are no sham trials of massage therapy for cervicothoracic pain. Massage is a commonly used to treat cervicothoracic pain. However, relatively few quality studies have been reported. Many studies have included massage as a component of a physical rehabilitation program, but not as the primary study focus.(497, 558, 577-579, 894, 908, 978, 980, 981, 1062) One moderate-quality trial evaluated therapeutic massage with self care instruction in chronic cervicothoracic pain patients. The exact massage protocol was individualized and included Swedish and therapeutic massage techniques. They reported significant improvement in Neck Disability Index, bothersomeness score, and Global Rating of Improvement at 4 and 10 weeks. However, at 26 weeks there was no statistical improvement in massage over self-care book. The benefit of massage was only present during the treatment period of 10 weeks.(1061) A moderate-quality trial comparing acupuncture, sham laser acupuncture, and conventional massage in chronic cervicothoracic pain, reported no significant improvement in the massage only group. Massage was 5 times over 3 weeks and the assessments were done at 1 week and 3 months after

treatment.(898) A moderate-quality study comparing traditional Chinese therapeutic massage vs stretching and moist heat vs control in chronic cervicothoracic pain reported significant improvement in the massage group. This improvement was maintained 6 weeks after the massage therapy stopped.(569) Two high-quality trials involving manual massage reported a benefit of massage compared to other modalities for treatment of subacute and chronic low back pain(1063, 1064) (see Low Back Disorders guideline). Massage is not invasive, has low risk of adverse effects aside from short-term pain, and is moderately costly.

## Evidence for the Use of Massage

There is 1 high-(583) and 18 moderate-quality RCTs (one with two reports)(497, 558, 569, 577-579, 894, 898Gam, 1998 #305, 978, 980, 981, 1004, 1061, 1062, 1065-1069) incorporated into this analysis. There are 2 low-quality RCTs in Appendix 1.(1043, 1070)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: massage, instrumentation, devices, equipment and supplies, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. In PubMed we found and reviewed 208 articles, and considered 9 for inclusion. In Scopus, we found and reviewed 36 articles, and considered 1 for inclusion. In CINAHL, we found and reviewed 19 articles, and considered 1 for inclusion. In Cochrane Library, we found and reviewed 1 articles, and considered 0 for inclusion. We also considered for inclusion 13 articles from other sources. Of the 281 articles considered for inclusion, 20 randomized trials and 5 systematic studies met the inclusion criteria.*

## Myofascial Release

Myofascial release is a soft tissue treatment technique that is most commonly used in the periscapular area to treat non-specific muscle soreness.(1071)

*Recommendation: Myofascial Release for Acute, Subacute, or Chronic Cervicothoracic Pain or Radicular Pain Syndromes or Other Back-related Conditions*

**There is no recommendation regarding myofascial release for the treatment of acute, subacute, or chronic cervicothoracic pain or radicular pain syndromes or other back-related conditions.**

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

## Rationale for Recommendation

While there are several RCTs, there are no sham or other quality trials on myofascial release in cervicothoracic pain to address its utility. Myofascial release is not invasive, has mild adverse effects, but is moderate to high cost depending on numbers of treatments. There is no recommendation for treatment of cervicothoracic pain or radicular pain syndromes.

## Evidence for the Use of Myofascial Release.

There are 4 moderate-quality RCTs incorporated into this analysis.(917, 997, 1072, 1073) There are 2 low-quality RCT in Appendix 1.(1074, 1075)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: myofascial release, myofascial therapy, myofascial trigger point therapy, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 118 articles, and considered 5 for inclusion. In Scopus, we found and reviewed 34 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 2 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 3 articles, and considered 0 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 5 articles considered for inclusion, 5 randomized trials and 0 systematic studies met the inclusion criteria.*

## Neuroreflexotherapy

Neuroreflexotherapy is an alternative treatment that was developed in Spain and involves implantation of numerous epidermal staples in trigger points in the back (or neck) as well as burins (small metallic punches) in “referred tender points in the ear” (1076) at depths up to 2mm.(1077) In contrast with acupuncture, the sites are chosen by dermatomal innervation. Implantation does not require anesthesia and staples remain in place for up to 90 days. Significant reductions in LBP have been reported at 1 year in uncontrolled studies.(1078)

*Recommendation: Neuroreflexotherapy for Acute, Subacute, or Chronic Cervicothoracic Pain with or without Radiculopathy*  
**Neuroreflexotherapy is not recommended for acute, subacute, or chronic cervicothoracic pain with or without radiculopathy.**

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

*Level of Confidence – Moderate*

### Rationale for Recommendation

There are no sham controlled or quality trials evaluating neuroreflexotherapy in cervicothoracic pain patients. There are observational studies that reported improvement in both cervical and thoracic pain patients with neuroreflexotherapy.(1078, 1079) Skin scarring on “exposed skin” results from this treatment, and without quality studies proving efficacy, this should be carefully considered.

### Evidence for the Use of Neuroreflexotherapy

There are no quality studies incorporated into this analysis.

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Neck pain, cervicgia, cervical pain, cervical radiculopathy, radicular Pain, postoperative neck pain postoperative cervical pain, herniated disk, neck pain, cervicgia, cervical pain, cervical radiculopathy, radicular pain, postoperative neck pain, postoperative cervical pain, herniated disk, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 680 articles, and considered 2 for inclusion. In Scopus, we found and reviewed 6 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 1 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 0 articles, and considered 0 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 2 articles considered for inclusion, 0 randomized trials and 0 systematic studies met the inclusion criteria.*

## Subcutaneous Carbon-dioxide Insufflations

Subcutaneous carbon-dioxide insufflations were used as a modality in naturopathy. Sources were often medical carbon-dioxide or gas from natural springs. The gas from natural springs contained more than just carbon-dioxide like nitrogen, argon, helium, and methane.(1080)

*Recommendation: Subcutaneous Carbon-dioxide Insufflation for Acute, Subacute, or Chronic Cervicothoracic Pain with or without Radiculopathy*

**Subcutaneous carbon-dioxide insufflation is moderately not recommended for treatment of acute, subacute, or chronic cervicothoracic pain with or without radiculopathy.**

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

*Level of Confidence – Moderate*

### Rationale for Recommendation

There are alternative sham controlled trials of subcutaneous carbon-dioxide insufflations for cervicothoracic pain. One moderate-quality study evaluated subcutaneous carbon-dioxide insufflation vs sham ultrasound in acute cervicothoracic pain. They reported no difference in time to pain resolution between the groups.(1081) One moderate-quality trial evaluated subcutaneous carbon-dioxide insufflation with physical therapy vs physical therapy alone in subacute/chronic cervicothoracic pain patients. They reported no significant findings between the groups when comparing pain perception or pain

intensity.(1080) These treatments are invasive, have adverse effects, are moderately costly to high cost depending on numbers of treatments, and are ineffective. Thus, they are not recommended.

## Evidence for the Use of Subcutaneous Carbon-dioxide Insufflation

There is 1 high-(1081) and 1 moderate-quality RCT incorporated into this analysis.(1080) There is 1 low-quality RCT in Appendix 1.(1082)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: subcutaneous carbon-dioxide insufflation, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed, we found and reviewed 2 articles, and considered both for inclusion. In Scopus, we found and reviewed 8 articles, and considered zero for inclusion. In CINAHL, we found and reviewed zero articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed zero articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the 23 articles considered for inclusion, 3 randomized trials and 0 systematic studies met the inclusion criteria.*

## Traction

Traction purportedly relieves “muscle spasm,” stretches muscles, reduces intradiscal pressure, and thus has been theorized to reduce disc herniation, and enlarge the intervertebral foramen removing pressure on the nerve root. (15, 562, 1083) However, traction has not been reported as successful in several trials.(15, 562, 1083, 1084) Duration and magnitude of force is adjustable and sometimes varied. Types of traction include motorized, manual, bed rest, pulley-weight, gravitational, suspension, and gravity inversion, (540, 562, 1083, 1085, 1086) with manual and motorized being most commonly used. When traction is used in combination with other treatment modalities, it is often difficult if not impossible to determine the benefit of traction alone as compared to the entire rehabilitation program.(974, 1087, 1088) A review by Graham et al. noted that there was no evidence supporting continuous traction, and inconclusive evidence for intermittent traction.(1087)

*Recommendation: Traction for Acute, Subacute, or Chronic Cervicothoracic Pain or Radicular Pain Syndromes*

**Traction is not recommended for treatment of acute, subacute, or chronic cervicothoracic pain or radicular pain syndromes.**

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

*Level of Confidence – Low*

## Rationale for Recommendation

There are sham trials evaluating traction in cervicothoracic pain. A high-quality study evaluated cervical traction in patients receiving a multimodal approach consisting of manual therapy and exercise. They reported no significant difference between the active and sham groups after 4 weeks of treatment.(562) A moderate-quality trial evaluated chronic cervicothoracic pain with radiculopathy, and compared 6 to 15 pounds of mechanical traction based on the patient’s weight to a sham 2 pounds of traction. They did not find any difference in outcomes at 3 months follow-up.(1083) Yet, a moderate quality trial found traction of additive benefit for radiculopathy.(564) A moderate-quality trial evaluated traction versus positioning versus collar versus two different types of placebo (heat and tablets) in chronic cervicothoracic pain with radiculopathy. The authors reported no significant difference in pain, ability to work, sleep, or range of motion.(15) A moderate-quality trial in patients with cervicothoracic pain with radiculopathy compared cervical traction, isometric exercises, postural advice and thiamin, to sham cervical traction (no weight added), NSAIDs, thiamine and advice. The authors reported a significant improvement in the cervical traction plus exercise group in pain score, tenderness index, pain frequency score, and VAS. However, it is difficult to assess if the improvement was a result of the traction or exercise.(540) A moderate-quality trial compared static cervical traction, intermittent cervical traction, manual traction and instruction for 6 weeks. They reported one statistically significant finding when comparing intermittent traction to instruction, increased right-sided cervical rotation. No other significant differences were reported.(1086) A moderate-quality study evaluated 6 to 12 pounds of cervical traction to sham traction and reported no significant difference in EMG activity after traction, pain, sleep or range of motion.(1084) In sum, there is no quality evidence that traction is efficacious. There are studies of mixed interventions (traction combined with

manual therapy and exercises) that suggest efficacy of a combined approach; however, as there is quality evidence that exercise is effective, this suggests the other treatments and not traction may be responsible for providing the efficacy. Unfortunately, clinical trials have often not established that adequate application of weight/traction force was applied. Thus, traction is not recommended.

Home traction units may be self-administered and thus not high cost. Some may consider attempting using these devices to treat select patients, particularly if manual distraction or traction testing of the cervical spine during examination obliterates or markedly centralizes neck and upper extremity symptoms, and is used in combinations with other treatments such as exercise. However, efficacy is not demonstrated and other treatments with evidence of efficacy are recommended to be utilized first.

## Evidence for the Use of Traction

There is 1 high- (562) and 12 moderate-quality (15, 540, 564, 571, 572, 900, 1083, 1084, 1086, 1089-1091) RCTs incorporated into this analysis. There are 5 low-quality RCTs in Appendix 1.(593, 1092-1095)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: traction, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 100 articles, and considered 10 for inclusion. In Scopus, we found and reviewed 585 articles, and considered 2 for inclusion. In CINAHL, we found and reviewed 21 articles, and considered 1 for inclusion. In Cochrane Library, we found and reviewed 8 articles, and considered zero for inclusion. We also considered for inclusion 1 article from other sources. Of the 17 articles considered for inclusion, 16 randomized trials and 1 systematic studies met the inclusion criteria.*

## Decompressive Devices

See Low Back Disorders Guideline.

## Electrical Therapies

### Interferential Therapy

Interferential therapy is a form of electrical stimulation using amplitude modification of two out-of-phase medium-frequency currents to produce a low-frequency current.(1096, 1097) This procedure is similar to TENS and differs by having less impedance in the tissues and is reportedly more comfortable than traditional TENS treatment.

1. *Recommendation: Interferential Therapy for Subacute or Chronic Cervicothoracic Pain with or without Radicular Pain*  
**Interferential therapy is not recommended for treatment of subacute or chronic cervicothoracic pain with or without radicular pain.**  
*Strength of Evidence – Not Recommended, Insufficient Evidence (I)*  
*Level of Confidence – Low*
2. *Recommendation: Interferential Therapy for Acute Cervicothoracic Pain with or without Radiculopathy*  
**Interferential therapy is not recommended for treatment of acute cervicothoracic pain with or without radiculopathy.**  
*Strength of Evidence – Not Recommended, Insufficient Evidence (I)*  
*Level of Confidence – Low*

### Rationale for Recommendations

There are no sham controlled or quality trials in cervicothoracic pain patients. In low back pain, there are two RCTs that included interferential therapy. They did not report any difference with outcome measures when compared to manipulation in acute LBP (1097) or traction and massage in chronic low back pain (1096) (see Low Back Disorders guideline).

## Evidence for the Use of Interferential Therapy

There are no quality studies incorporated into this analysis.

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: interferential therapy, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. In PubMed we found and reviewed 753 articles, and considered 0 for inclusion. In Scopus, we found and reviewed 28 articles, and considered 6 for inclusion. In CINAHL, we found and reviewed 0 article, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 1 article, and considered 1 for inclusion. We also considered for inclusion 15 articles from other sources. Of the 0 articles considered for inclusion, 0 randomized trials and 0 systematic studies met the inclusion criteria.*

## Microcurrent Electrical Stimulation

Microcurrent electrical stimulation is a type of electrotherapy. Proponents believe that it will relieve pain and contribute to healing while using lower currents than are used in TENS or interferential and galvanic stimulation.

*Recommendation: Microcurrent Electrical Stimulation for Acute, Subacute, or Chronic Cervicothoracic Pain with or without Radiculopathy*

**Microcurrent electrical stimulation is not recommended for acute, subacute, or chronic cervicothoracic pain with or without radicular pain syndromes.**

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

*Level of Confidence – Low*

## Rationale for Recommendation

There are no sham controlled or quality trials of microcurrent electrical stimulation in cervicothoracic pain. There are no quality trials in other spinal conditions either (see Low Back Disorders guideline).

## Evidence for the Use of Microcurrent Electrical Stimulation

There are no quality studies incorporated into this analysis.

*A comprehensive literature search was conducted using PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Microcurrent Stimulation, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. In PubMed we found and reviewed 740 articles, and considered 0 for inclusion. In Scopus, we found and reviewed 4 articles, and considered 0 for inclusion. In CINAHL, we found and reviewed 0 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 0 articles, and considered 0 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 0 articles considered for inclusion, 0 randomized trials and 0 systematic studies met the inclusion criteria.*

## Transcutaneous Electrical Neurostimulation (TENS) And Neuromuscular Electrical Stimulation (NMES)

Transcutaneous electrical nerve stimulation (TENS) is a modality to control pain through electrical stimulation delivered by pads placed on the surface of the skin thought to relieve pain of both non-inflammatory and inflammatory disorders through distraction or alternate nerve pathway conduction (gate theory).(1098, 1099) Two of the more commonly utilized protocols are either a low-intensity prolonged (30 plus minutes) stimulation through an active electrode over the painful area or a higher intensity over the painful area for 15 to 30 minutes (commonly referred to as hyperstimulation analgesia).(1100) High-

frequency stimulation is generally 80 to 200 Hz, whereas low frequency is generally 4 to 8 Hz. Some studies do not report the frequency of the stimulation.(1101)

1. *Recommendation: TENS for Acute or Subacute Cervicothoracic Pain or Acute Radicular Pain Syndromes*  
**TENS is not recommended for acute or subacute cervicothoracic pain or acute radicular pain syndromes.**  
*Strength of Evidence – Not Recommended, Insufficient Evidence (I)*  
*Level of Confidence – Low*

### Rationale for Recommendation

There are no sham controlled trials in acute or subacute cervicothoracic pain patients with or without radicular pain. There is one moderate-quality trial comparing TENS (15 to 30 minutes, 3 times a week for 4 weeks) versus manual therapy vs cervical collar for treatment of acute cervicothoracic pain. It suggested a minimal statistical improvement in range of motion. However, there was no significant difference in pain with TENS therapy at one week compared to manual therapy and neck collar use alone and all patients in the trial were recovered by 6 weeks.(1089) TENS is not invasive, has low adverse effects and is moderate to high cost depending on numbers of treatments. There are other interventions with documented efficacy for treatment of acute and subacute cervicothoracic and radicular pain syndromes.

2. *Recommendation: TENS for Chronic Cervicothoracic Pain*  
**TENS is recommended for select use in patients with chronic cervicothoracic pain as an adjunct for more efficacious, active treatments.**

*Indications –* TENS (single or dual channel) is recommended as a treatment choice for chronic cervicothoracic pain when clear objective and functional goals are being achieved that include increased physical activity and/or reductions in medication use. TENS is recommended to be utilized as adjunctive treatment in chronic cervicothoracic pain to support graded strengthening and aerobic exercises.(9, 894) For patients who are not involved in a conditioning program or who are non-compliant with graded increases in activity levels, this intervention is not recommended. It is recommended TENS units be trialed (rented) prior to purchase to demonstrate efficacy and increase function.

*Frequency/Duration –* One or 2 sessions to instruct patient in use of TENS. Subsequent use is self-applications.

*Indications for Discontinuation –* Resolution, intolerance, or non-compliance including non-compliance with progressive strengthening and aerobic exercises.

*Strength of Evidence – Recommended, Insufficient Evidence (I)*  
*Level of Confidence – Low*

### Rationale for Recommendation

There is one sham-controlled RCT evaluating efficacy of TENS in chronic cervicothoracic pain and suggested improvement in trigger point tenderness with microcurrent when compared to sham treatment after 6 treatments over 2 weeks.(1102) Since trigger points are only palpated during physical exam, this is not a useful measure of functional outcome. A moderate-quality trial compared TENS plus infrared therapy, exercise plus infrared therapy, and infrared irradiation in patients with >3 months of intermittent cervicothoracic pain. They reported decreased pain scores, increased isometric strength, decreased analgesic use, less sick days for neck pain, and reduction in Northwick Park Cervicothoracic Pain Questionnaire in the TENS and exercise group up to 6 months after therapy.(575) Thus it is not clear whether the benefit is due entirely to exercise, or whether TENS facilitated exercise. TENS is not invasive, has no significant adverse effects, but is moderate to high cost. The balance of quality studies of the cervicothoracic spine, as well as the highest quality studies performed on the lumbar spine suggest efficacy; thus, TENS is recommended for select chronic cervicothoracic pain cases as an adjunct to an active exercise program.

### Evidence for the Use of TENS

There is 1 high-(962) and 9 moderate-quality(575, 582, 894, 996, 1089, 1102-1105) RCTs incorporated into this analysis. There is 1 low-quality RCT in Appendix 1.(1106)

*A comprehensive literature search was conducted using PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: Transcutaneous electrical nerve stimulation, TENS, Neuromuscular Electrical Stimulation, NMES, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain; controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation,*



random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 70 articles, and considered 12 for inclusion. In Scopus, we found and reviewed 163 articles, and considered zero for inclusion. In CINAHL, we found and reviewed 25 articles, and considered zero for inclusion. In Cochrane Library, we found and reviewed 20 articles, and considered zero for inclusion. We also considered for inclusion zero articles from other sources. Of the 12 articles considered for inclusion, 11 randomized trials and 1 systematic study met the inclusion criteria.

## Percutaneous Electrical Nerve Stimulation (Pens)

See Low Back Disorders Guideline.

## High-Voltage Galvanic Therapy

High-voltage galvanic is an electrical therapy that uses a twin-spike, monophasic pulsed current waveform with peak spike amplitudes of up to 500 V and pulse durations of about 50 to 200m sec at frequencies ranging from 1 to approximately 120 twin-spike pulses per second. Most devices allow the user to select and manually switch the polarity of the output leads.

*Recommendation: High-voltage Galvanic Therapy for Chronic Cervicothoracic Pain*

**High-voltage galvanic therapy is not recommended for treatment of chronic cervicothoracic pain.**

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

*Level of Confidence – Low*

### Rationale for Recommendation

High-voltage galvanic is not proven efficacious for the treatment of chronic cervicothoracic pain. The single quality study suggests possible minimal, brief improvement for neck pain.(1107) While high-voltage galvanic is not invasive and not low cost, there are other interventions shown to be effective.

### Evidence for the Use of High-voltage Galvanic

There is 1 moderate-quality RCT incorporated into this analysis.(1107)

*A comprehensive literature search was conducted using multiple search engines including PubMed, Scopus, CINAHL and Cochrane Library without date limits using the following terms: high voltage galvanic therapy, high voltage galvanic, pulsed frequency electromagnetic therapy, high voltage galvanic stimulation, high voltage pulsed current, direct current stimulation, cervicalgia, pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, postop, postoperative\*, postoperative, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. In PubMed we found and reviewed 5 articles, and considered 2 for inclusion. In Scopus, we found and reviewed 1 article, and considered 0 for inclusion. In CINAHL, we found and reviewed 0 articles, and considered 0 for inclusion. In Cochrane Library, we found and reviewed 161 articles, and considered 0 for inclusion. We also considered for inclusion 0 articles from other sources. Of the 167 articles considered for inclusion, 1 randomized trial and 2 systematic studies met the inclusion criteria.*

## Injection Therapies

### Botulinum Injections

Botulinum injections have been used to produce muscle paresis and have antinociceptive properties.(670, 1108) They have also been used in myofascial pain syndrome (see Shoulder Disorders guideline). This treatment is also used for cervical dystonia (spasmodic torticollis), although that is beyond the scope of this guideline.(1109-1112)

*Recommendation: Botulinum Injections for Non-specific Acute, Subacute, or Chronic Cervical Pain, Cervical Myofascial Pain or Cervicogenic Headaches*

**Botulinum injections are moderately not recommended for treatment of non-specific acute, subacute or chronic cervical pain, cervical myofascial pain,(1113-1120) or cervicogenic headaches.(1121-1125)**

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

## Rationale for Recommendation

High and moderate quality studies evaluating botulinum injections for the management of neck pain or tension headaches demonstrate no clear benefits greater than placebo (1126-1131), although a few lower-quality studies suggest some potential efficacy (1541, 1542). These injections are invasive, have high adverse effects including reported deaths, are costly, have no quality evidence of efficacy and are not recommended.

## Evidence for the Use of Botulinum Injections

There are 5 high-(1108, 1114, 1126, 1128, 1132) and 14 moderate-quality RCTs incorporated into this analysis.(1113, 1115-1125, 1127, 1129) There are 7 low-quality RCTs in Appendix 1.(1133-1139)

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*Botulinum, botox, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies to find 1398 articles. Of the 1398 articles, we reviewed 78 articles and included 33 articles (27 randomized controlled trials and 6 systematic reviews).*

## Cervical Epidural Injections

Epidural glucocorticosteroid injections (ESI) are performed in an attempt to deliver the active medication as close to the target tissue as possible, whether most commonly a herniated disc or spondylosis.(1140-1146) For transforaminal ESI, complications rarely occur, but include infection (meningitis, epidural abscess, etc.) and hemorrhage related to penetration of an anatomical variant artery, nerve root injury, vertebral artery dissection, paralysis, and stroke.(1147, 1148) Due to proximity of the spinal cord, ESIs in the cervical spine are thought to have a higher adverse effect profile. A resulting epidural hematoma may compress the nerve or spinal cord (1140) and generally requires emergency surgery. Intralaminar ESI may have a disadvantage in not getting the medication anteriorly (the site of inflammation), but have less risk of inadvertent arterial injection of particulate steroid.(1147-1152) There have not been quality trials reported comparing transforaminal vs. intralaminar cervical ESIs.(1153)

1. *Recommendation: Epidural Glucocorticosteroid Injections for Acute, Subacute, or Chronic Cervical Radicular or non-Radicular Pain*

**Epidural glucocorticosteroid injections, including selective nerve root injections, are not recommended for acute, subacute, or chronic radicular or non-radicular pain syndromes.**

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

*Strength of Evidence – Not Recommended, Evidence (C) – Non-Radicular pain*

*Level of Confidence – Moderate*

2. *Recommendation: Continuous Infusion of Local Corticosteroids and Local Anesthetic for Acute, Subacute, or Chronic Cervicothoracic Pain with or without Radiculopathy*

Continuous infusion of local corticosteroids and local anesthetic for acute, subacute, or chronic cervicothoracic pain with or without radiculopathy.

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

*Level of Confidence – Moderate*

## Rationale for Recommendation

There is a lack of quality trials for treatment of patients with acute or subacute cervicothoracic radicular pain. There is quality evidence documenting relatively weak efficacy for lumbar radiculopathy (see Low Back Disorders guideline). However, the risks of adverse effects are greater in the cervical spine than in the lumbar spine and have included quadriplegia.(1154, 1155) Thus epidural, intralaminar, and transforaminal approaches for epidural steroid injections and selective nerve root injections for radicular pain are not recommended.(1156)

Regarding non-radicular pain, there are no quality saline controlled trials although there are two trials with local anesthetic injections. A moderate-quality RCT compared methylprednisolone 40mg with 0.5ml carbocaine to 0.5ml carbocaine and 1ml saline. The authors reported a between-group difference of a 17% reduction in pain symptoms in the steroid group and 16% reduction of pain in the non-steroid group. They performed fluoroscopically guided transforaminal injections in patients who had positive diagnostic nerve root blocks performed before randomization. They included patients with MRI diagnoses of foraminal stenosis and hard disc disease.(1157) Another study compared 5ml lidocaine with 5ml lidocaine and 6mg betamethasone and reported no significant difference between groups at 12 months.(1158) A moderate-quality study compared triamcinolone 10mg/ml (dose was variable and dependent on volume injected) plus 0.5% lidocaine with triamcinolone, 0.5% lidocaine and 2.5mg morphine without any significant difference between the groups. They included patients who had x-rays, myelography, CT scan, and electrophysiology tests that did not reveal any pathology. The patients had undergone medical treatment for at least 12 months including NSAIDs, activity restrictions, physiotherapy, and other medical treatments and failed to respond. The overall improvement was 79.2% improvement to complete, excellent, or good pain control at 12 months.(1159) Another moderate-quality study comparing methylprednisolone 80mg with 5ml 1% lidocaine into the cervical epidural space to injection of the same medications into posterior neck muscles reported decreased pain and increased range of motion at 12 months in the epidural injection group.(1160) Thus, there is quality evidence that epidural steroid injections are not successful for treatment of chronic cervical radiculopathy and these injections are not recommended.

There are no sham-controlled studies of continuous infusion into the cervical spine. There is a moderate-quality study comparing continuous 0.25% bupivacaine with boluses of methylprednisolone 40mg every 4 to 5 days via catheter with 0.25% bupivacaine with epinephrine with 80mg methylprednisolone acetate with a 4 to 5 day interval between injections. Patients were classified as “resistant” to conventional therapy. They had CT or MRI exams with evidence of herniated nucleus pulposus or cervical spondylosis. Follow up at 6 months did not find statistical difference for the patients with pain <180 days duration. In patients with >180 days duration of pain the study reported improved pain control and number of pain-free hours compared to injection treatment.(1161) These procedures are quite invasive on a cumulative basis and thus are not recommended pending reporting of quality trials, particularly with placebo or sham control.

## Evidence for the Use of Cervical Epidural Injections

There is 1 high-(1162) and 14 moderate-quality RCTs (1157-1159, 1161, 1163-1172) incorporated into this analysis. There are 3 low-quality (1160, 1173, 1174) RCTs and 3 other studies(1175, 1176) in Appendix 1.

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*epidural injection, glucocorticoid, steroid injection, dexamethasone, betamethasone, methylprednisolone, triamcinolone, neck pain, cervicalgia, cervical pain, cervical radiculopathy, radicular pain, postoperative neck pain, postoperative cervical pain, herniated disk, controlled clinical trial, controlled trails, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies to find 815 articles. Of the 815 articles, we reviewed 83 articles and included 30 articles (20 randomized controlled trials and 10 systematic reviews).*

## Radiofrequency Neurotomy, Neurotomy, And Facet Rhizotomy

Facet joints (“zygapophysial joints”) are thought the source of pain for some patients with chronic cervicothoracic pain.(1177) Patients who experience pain relief from the injection of anesthetic along the nerve roots innervating the joints (“diagnostic blocks”) are thought by some to be candidates for various neurotomy procedures. Radiofrequency neurotomy involves the use of a radiofrequency electrode to create a heat lesion to coagulate (destroy) the nerve supplying the facet joint, and some

surrounding muscle.(1178-1182) If the theory is correct and the patient correctly diagnosed, the procedure should result in complete or near-complete relief of cervicothoracic pain.(1183)

1. *Recommendation: Radiofrequency Neurotomy, Neurotomy, or Facet Rhizotomy for Chronic Cervicothoracic Pain*  
**There is no recommendation for or against the use of radiofrequency neurotomy, neurotomy, or facet rhizotomy for the treatment of chronic cervicothoracic pain confirmed with diagnostic blocks, but who do not have radiculopathy and who have failed conservative treatment.** (64% panel agreement; 36% of panel agreed with limited indications as indicated below.)

*Indications-* Chronic cervicothoracic pain patients without radiculopathy who failed conservative treatments and who have had a confirmed diagnosis by medial branch blocks.(69)

*Frequency/Duration* – One procedure might be tried after failure of non-invasive treatments including NSAIDs and a quality exercise program or as a means to help with participation in an active rehabilitation program. There is no recommendation for repeated procedures. It is reasonable to attempt a second lesion after 26 weeks in patients who had greater than 80% improvement in pain from first procedure for the first 8 weeks with a late return of pain.(1184) There is no recommendation for a third or for additional procedures. There is logically a limit as to how many times it is possible to permanently destroy the same nerve.

*Indications for Discontinuation* – Resolution of symptoms. If there is no response to the first procedure, there is no evidence that a second lesion will be beneficial.

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

*Level of Confidence* – **Low**

2. *Recommendation: Radiofrequency Neurotomy for Cervicogenic Headache*  
**Radiofrequency neurotomy is moderately not recommended for the treatment of cervicogenic headache.**

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

*Level of Confidence* – **Low**

## Rationale for Recommendations

A moderate-quality, sham controlled trial evaluating patients with cervical zygapophyseal-joint pain diagnosed with anesthetic blocks, but without any radicular symptoms, showed improvement in pain over a sham procedure at 12 months. However, there were statistically more patients in the sham group involved in litigation over the accident that caused their pain ( $p = 0.04$ ) than in the intervention group.(1184) Thus, even though the study's methodology scores were good, it has a potential fatal flaw or bias. Another moderate-quality study assessing radiofrequency denervation of facet joints C2-C6 for cervicogenic headache (CH) compared to a sham procedure did not have any significant improvements at 12 or 24 months.(1177) A study evaluating radiofrequency versus occipital nerve block did not find any benefit of radiofrequency lesions over nerve block in cervicogenic headache patients.(1185) Studies in the lumbar spine are increasingly suggesting lack of efficacy (1543–1547), including the largest-sized trial that found neurotomy to be ineffective compared with an exercise program for treatment of LBP, SI joint pain, or intervertebral disc pain (1548). The initial study for the cervical spine (1187) suggesting efficacy was small-sized, is now more than 20 years old, and has not been reproduced in a quality study, which is concerning.

As results can be permanent, there should be good evidence of long-term benefit prior to recommending this procedure. Radiofrequency lesioning is invasive, has adverse effects, and is costly. There is evidence of a lack of efficacy for treatment of lumbar pain, thus there is an unreconciled dispute in the literature (ineffective in the lumbar spine, but perhaps some efficacy in the cervical spine). This is not recommended as a first or second line procedure and is recommended only in the setting of participation in an active rehabilitation program in a patient who is motivated to increase his/her daily functioning.

## Evidence for the Use of Radiofrequency Neurotomy, Neurotomy, and Facet Rhizotomy

There is 1 high-(1186) and 4 moderate-quality RCTs (1177, 1184, 1185, 1187) incorporated into this analysis.

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

radiofrequency neurotomy, neurotomy, facet rhizotomy, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies. to find 369 articles. Of the 369 articles, we reviewed 369 articles and included 11 articles (6 randomized controlled trials and 5 systematic reviews).

## Dorsal Root Ganglia Radiofrequency Lesioning

Radiofrequency lesioning of the dorsal root ganglia has been attempted for treatment of chronic cervical radiculopathy.

*Recommendation: Radiofrequency Lesioning for Chronic Cervical Radiculopathy*

**There is no recommendation for or against radiofrequency lesioning of the dorsal root ganglia for chronic cervical pain with or without radiculopathy.**

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

*Level of Confidence – Moderate*

### Rationale for Recommendation

A moderate-quality study evaluated 67°C radiofrequency lesion compared to sham therapy. Patients were diagnosed with chronic cervicobrachial pain for at least 1 year with positive diagnostic segmental nerve blocks. Assessment was done at 8 week after a single segmental lesion or sham was conducted. They reported a significant decrease in pain in the intervention group over the sham therapy group ( $p < 0.01$ ). They also reported a higher incidence of adverse effects with the intervention group, including burning nerve pain and hypesthesias.(1188) A moderate-quality study evaluated 67°C radiofrequency lesion compared to 40°C radiofrequency lesion at a single level. The participants had chronic cervicobrachial pain (mean duration 7 plus years) that had failed conservative therapy and had a positive diagnostic block with local anesthetic. They found improvement in both groups, but no statistical difference between the groups. They also reported side effects of neuritis and decreased pinch strength in the treated side.(1189) Thus a small study ( $n = 20$ ) found some benefit at 8 weeks, with some complications, but a larger study ( $n = 61$ ) found no benefit at 3 months. If effective despite some significant side effects the duration of relief appears to be too short to justify a recommendation in patients with chronic pain.

Radiofrequency lesioning is invasive, has adverse effects, and is costly. It is not recommended as a first or second line therapy and only in patients who have failed conservative therapy. The patient should be committed to participation in active rehabilitation after the procedure as the pain relief has not been shown to be permanent and there is no evidence for repeated lesioning.

### Evidence for the Use of Radiofrequency Lesioning of the Dorsal Root Ganglia

There are 3 moderate-quality RCTs incorporated into this analysis.(1188-1190)

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*Dorsal root ganglia radiofrequency, cervical discectomy, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies to find 901 articles. Of the 901 articles, we reviewed 8 articles and included 7 articles (3 randomized controlled trials and 4 systematic reviews).*

### Facet Joint Hyaluronic Acid Injections

Facet joint injections with hyaluronic acid are being attempted for treatment of facet degenerative joint disease.(1179, 1191) These injections are analogous to similar injections in the knee and other arthritic joints.

*Recommendation: Facet Joint Hyaluronic Acid Injections for Acute, Subacute, or Chronic Cervicothoracic Pain with or without Radicular Pain Syndromes*

**Facet joint injections with hyaluronic acid are not recommended for acute, subacute, or chronic cervicothoracic pain with or without radicular pain syndromes.**

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

*Level of Confidence – Low*

## **Rationale for Recommendation**

There are no sham controlled or quality trials of hyaluronic facet joint injections in cervicothoracic pain. There is one moderate-quality trial evaluating facet hyaluronic facet joint injection compared to steroid facet joint injections that reported some benefit; however, the comparison group has not been shown to be beneficial.(1191) This procedure is invasive, requiring a series of 18 injections performed at 3 levels, so radiation exposure is significant, and is high cost. Additional studies need to be conducted in spinal conditions (see Low Back Disorders guideline).

## **Evidence for the Use of Facet Joint Hyaluronic Acid Injections**

There are 2 high- (1192, 1193) and 1 moderate-quality (1191) RCT incorporated into this analysis. There are 2 low-quality (1194, 1195) RCTs in Appendix 1.

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*Zygapophyseal Joint, Facet Joints, Facet Joint injections, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies.*

*to find 909 articles. Of the 909 articles, we reviewed 909 articles and included 4 articles (3 randomized controlled trials and 1 systematic reviews).*

## **Intrathecal Drugs**

See Low Back Disorders Guideline.

## **Intradiscal Electrothermal Therapy (IDET)**

Intradiscal electrothermal therapy (IDET) involves the heating of an intradiscal probe through electrical current. The goal is to coagulate tissue and theoretically result in improvement in pain thought to be derived from the disc or surrounding structures.(1196, 1197) Techniques have not been standardized.

*Recommendation: Intradiscal Electrothermal Therapy for Acute, Subacute, or Chronic Cervicothoracic Pain with or without Radicular Pain Syndromes*

**Intradiscal electrothermal therapy is not recommended for acute, subacute, or chronic cervicothoracic pain with or without radicular pain syndromes.**

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

*Level of Confidence – Moderate*

## **Rationale for Recommendation**

There are no sham controlled or quality trials of intradiscal electrothermal therapy in cervicothoracic pain. In low back pain there are two high-quality RCTs (1198, 1199) that unequivocally conflict regarding whether IDET has any value in treating chronic low back pain. IDET has not been clearly shown to be beneficial. It is costly and invasive, although it may have a relatively low complication rate.(1200) Thus, there is not adequate evidence to recommend this procedure for any spinal indication (see Low Back Disorders guideline).

## **Evidence for the Use of Intradiscal Electrothermal Therapy (IDET)**

There are no quality studies incorporated into this analysis.

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms: Intradiscal electrothermal therapy, IDET ; cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies.*

*to find 1398 articles. Of the 1398 articles, we reviewed 1398 articles and included 0 articles (0 randomized controlled trials and 0 systematic reviews).*

## **Percutaneous Intradiscal Radiofrequency Thermocoagulation (PIRFT)**

Percutaneous intradiscal radiofrequency thermocoagulation involves the same principle as that of IDET; however, the heating of an intradiscal probe is through radiofrequency instead of electrical current.(1201) The theoretical mechanisms of efficacy are essentially the same as for IDET.

*Recommendation: Percutaneous Intradiscal Radiofrequency Thermocoagulation for Acute, Subacute, or Chronic Cervicothoracic Pain with or without Radicular Pain Syndromes*

**Percutaneous intradiscal radiofrequency thermocoagulation is not recommended for acute, subacute, or chronic cervicothoracic pain with or without radicular pain syndromes.**

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

*Level of Confidence – Moderate*

## **Rationale for Recommendation**

There are no sham controlled or quality trials of percutaneous intradiscal radiofrequency thermocoagulation therapy in cervicothoracic pain. In low back pain, a high-quality trial of 28 patients compared PIRFT versus placebo for chronic discogenic LBP with at least 50% pain relief on analgesic discography was conducted. At 8 weeks, there were two successes in the sham group and one in the PIRFT group.(1201) A moderate-quality trial compared different lengths of PIRFT (120 versus 360 seconds) and suggested there is no long-term benefit from PIRFT(1202) (see Low Back Disorders guideline).

## **Evidence for the Use of PIRFT**

There are no quality studies incorporated into this analysis.

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*percutaneous intradiscal radiofrequency thermocoagulation, PIRFT, intradiscal annulopathy, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies.*

*to find 1074 articles. Of the 1074 articles, we reviewed 1074 articles and included 0 articles (0 randomized controlled trials and 0 systematic reviews).*

## **Prolotherapy Injections**

Prolotherapy involves repeated injections of irritating, osmotic, and chemotactic agents (e.g. dextrose, glucose, glycerin, zinc sulphate, phenol, guaiacol, etc.), combined with an injectable anesthetic agent to reduce pain, into back structures, especially

ligaments. The theory is that the injections will stimulate a healing response and thus strengthen the tissues.(1203-1206) A retrospective case series found prolotherapy to improve pain and disability in patients with chronic spinal pain.(1207)

*Recommendation: Prolotherapy Injections for Acute, Subacute, or Chronic Cervicothoracic Pain with or without Radicular Pain Syndromes*

**Prolotherapy injections are not recommended for acute, subacute, or chronic cervicothoracic pain with or without radicular pain syndromes.**

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

*Level of Confidence – Moderate*

## Rationale for Recommendation

There are no sham controlled or quality trials of prolotherapy injections in cervicothoracic pain. In low back pain the highest quality trial reported no benefit of prolotherapy injections (1203) (see Low Back Disorders guideline).

## Evidence for the Use of Prolotherapy Injections

There are no quality studies incorporated into this analysis.

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:proliferation therapy, regenerative injection therapy, proliferative injection therapy, prolotherapy injections, prolotherapy injection, prolotherapy, postop, postoperative, postoperative, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies to find 1103 articles. Of the 1103 articles, we reviewed 1103 articles and included 3 articles (0 randomized controlled trials and 1 systematic reviews).*

## Trigger Point Injections

See Shoulder Disorders guideline.

## Surgical Considerations

This guideline will address only the non-emergent surgical treatment of the most common acute, subacute, and chronic neck and thoracic spine problems. The indications for emergent surgery for red flag conditions including acute spinal cord compression (myelopathy), unstable fractures, epidural abscess, or hematoma, etc., will not be discussed, as treatment of these conditions is outside the scope of these guidelines, as are other indications for surgery (e.g., neoplasms). Early recognition of red flag conditions that require expedited referral to a surgeon qualified to deal with spine emergencies is recommended (see Red Flags).

Within the first 3 months after onset of acute neck or thoracic spine symptoms, surgery is considered for serious spinal pathology, nerve root compression not responsive to an adequate trial of conservative therapy generally considered to require at least 6 weeks, or the development of a documented, progressive neurological deficit. Disc herniation, characterized by protrusion (or extrusion, which is also referred to as a “free fragment”) of the central nucleus pulposus through a defect in the outer annulus fibrosus, may impinge on a nerve root typically causing mostly referred shoulder and arm symptoms accompanied by nerve root dysfunction. However, the presence of a herniated disc on an imaging study is common and in isolation, does not imply nerve root dysfunction.(1208) Studies of asymptomatic adults commonly demonstrate intervertebral disc protrusions that apparently do not cause symptoms. Many middle aged individuals with radiculopathy have nerve root syndromes due to a combination of disc protrusion and degenerative osteophytes (“disc-osteophyte complex”). One key feature associated with the development of neurological impingements, including spinal stenosis particularly with myelopathy, is having a congenitally narrow cervical spinal canal diameter.



Studies have strongly suggested spontaneous disc resorption without surgery in the lumbar spine (348) (A retrospective case series suggested most thoracic herniations, while rare, also do not require surgery.(1209)) Many patients with strong clinical findings of nerve root compression due to disc herniation and/or spinal stenosis recover activity tolerance within 1 month. There is no quality evidence that delaying surgery for this period worsens outcomes in the absence of progressive nerve root compromise. With or without surgery, most patients with apparent surgical indications eventually recover to their pre-morbid activity level, (512) including those with severe initial presenting signs of neurological compromise. Spine surgery for patients with clear indications appears to speed short- to mid-term recovery (see Low Back Disorders guideline). However, spine surgery also statistically increases the risk for future spine procedures with higher complication rates. In older patients (1210) and repeat procedures, the success rate is lower and rate of complications is higher. Patients with comorbid conditions such as smoking, cardiac or respiratory disease, diabetes, or mental illness, may be poorer candidates for surgery.(1211-1213) Comorbidity should be weighed and discussed carefully with the patient.

Therefore, referral for surgical consultation is recommended for patients who have the following:

- Severe and disabling arm or shoulder symptoms (“brachalgia”) referred from the neck (radiculopathy) in a distribution consistent with nerve root compression on imaging studies, preferably with accompanying objective signs of neural compromise; *and*
- Activity limitations due to radiating brachalgia pain for more than 6 weeks; (361-364) *and*
- Imaging evidence of a lesion (disc herniation, spinal stenosis, spondylolisthesis) with clear clinical correlation to the patient’s symptoms and physical findings (at the correct level and on the correct side); (361-364) *and*
- Failure of time and an adequate trial of conservative treatment to resolve disabling radicular symptoms; (361-364) *or*
- Evidence of chronic spinal cord compression (myelopathy) by physical exam, or bowel or bladder control symptoms/studies, with imaging evidence of spinal cord compression; *or*
- Documented progressive neurologic deficit, particularly motor loss.

If surgery is a consideration, counseling regarding likely outcomes, risks, and benefits and especially expectations is important. Patients with cervical pain/headache alone, without findings of serious spinal pathology (such as tumor, fracture, infection, hematoma), rarely derive benefit from surgery, although a second opinion from a spine surgeon to the effect that surgery is not recommended and is unlikely to be helpful may be reassuring to the patient.

Before surgery, physicians may consider referral for psychological evaluation to improve surgical outcomes, including evaluation for predictive variables.(57, 1214-1216) In addition, physicians may look for non-organic signs (similar to Waddell’s non-organic signs in the lumbar spine) during the physical exam.(121)

## Cervical and Thoracic Nerve Root Decompression

Cervical nerve root decompression is performed for symptomatic nerve roots compression by disc herniation and/or spinal stenosis.(361-364, 512) Thoracic nerve root decompression is an infrequent condition and surgery is rarely required. A population based study found very low rates of thoracic spine surgery in Japan.(1217) A retrospective case series found few thoracic spine cases.(1218) A retrospective case series suggested most thoracic herniations, while anatomically common (64) but clinically rare, also do not require surgery.(1209) Direct methods of nerve root decompression include standard open discectomy, laminotomy/foramenotomy, facetectomy, and laminectomy.

The number of different surgical procedures performed for cervical spine disorders has increased with time. Well designed, high-quality randomized controlled clinical trials with sufficient follow-up time are mostly unavailable [comparisons with sham procedures, no treatment groups, non-operative treatment, or comparisons between surgical procedures (see evidence table;(512)]. Thus, the overall quality of the literature limits robust conclusions regarding appropriate procedures for cervical disorders with radiculopathy or myelopathy. The increased variety of procedures to address the same diagnosis suggests quality trials are strongly needed to assist in better defining specific procedures for particular patients.

## Discectomy, Microdiscectomy, Sequestrectomy, Endoscopic Decompression

There are multiple surgical techniques that have been used to surgically relieve pressure on cervical nerve roots causing radicular pain syndromes, and these largely parallel studies of the lumbosacral spine. These include open anterior (361-364, 1219, 1220) or posterior discectomy (with or without microscope), (1221-1225) sequestrectomy, and foramenotomy. Additional techniques include percutaneous laser disc ablation or decompression, (1226-1232) automated percutaneous discectomies (also known as nucleoplasty), (1233-1236) and disc coblation.(400, 1237, 1238)

The same surgical approaches are also sometimes used to address less common spinal pathology (e.g., facet joint arthropathy with consequent nerve root impingement). This section reviews the indications for discectomy for a herniated cervical disc.

In contrast with the lumbar spine, cervical discectomy has been frequently combined with fusion as an initial surgical approach, (410, 1239-1241) although more recently, endoscopic approaches are being increasingly utilized.(1242) Cervical discectomy with fusion with allografts and plate fixation has been advocated for treatment with comparable clinical outcomes, but no iliac crest morbidity.(1240, 1243) Use of polyetheretherketone (PEEK Cages with demineralized bone matrix) has been used to produce fusion without the need for harvesting an iliac crest bone graft.(1244-1246) Similarly, use of an anterior cervical plate yields a very high rate of fusion. Some particularly advocate a combined discectomy plus fusion approach for ‘hard” disc (osteophyte) disease, or degenerative changes with osteophytes where discectomy is felt to be insufficient to relieve neurological impingement. Nevertheless, posterior discectomy alone for either soft or hard discs continues to be performed and has been found to have shorter operative times, hospital stays, and work absences, but no difference in arm pain relief or anatomical fusion compared with discectomy with fusion.(361-364, 1247, 1248) Patients treated with isolated anterior discectomy without fusion have similar relief of arm pain compared to patients treated with anterior cervical discectomy and fusion, but they have more severe and more prolonged cervical pain. Thus anterior discectomy without fusion is now uncommonly performed.

1. *Recommendation: Cervical Discectomy for Subacute or Chronic Radiculopathy*

**Cervical discectomy is recommended to speed recovery in patients with subacute or chronic radiculopathy due to ongoing nerve root compression who continue to have significant pain and functional limitation after at least 6 weeks of time and appropriate non-operative therapy.**(361-364, 1242, 1249-1251) Patients who are candidates for discectomy should be informed that (other than rare cases with significant and/or progressive neurological deficit or surgical emergencies), there is evidence there is no need to rush surgical decisions as there appear to be no differences in long-term functional recovery whether the surgery is performed early or delayed. Open discectomy, microdiscectomy, and endoscopic discectomy are all potentially appropriate ways to perform discectomy. The decision as to whether to use an anterior or a posterior approach, and what technique to achieve a fusion (which procedure to choose) should be left to the surgeon and the patient until quality evidence becomes available to provide evidence-based guidance. **Percutaneous discectomy (nucleoplasty), laser discectomy, and disc coblation are discussed in recommendation #4.**

*Indications* – All of the following present: 1) radicular pain syndrome with current dermatomal pain and/or numbness, or myotomal muscle weakness, or ongoing denervation changes by needle EMG consistent with radiculopathy from a herniated disc; 2) imaging findings by MRI, or CT with or without myelography, that confirm persisting nerve root compression at the level and on the side predicted by the history and clinical examination; and 3) continued significant pain and functional limitation after at least 6 weeks of time and appropriate non-operative treatment.(361-364, 1242)

*Benefits* – Earlier pain relief

*Harms* – Operative complications that very rarely include severe adverse effects or fatality comparable with other moderate surgical procedures.

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

*Level of Confidence* – **High**

2. *Recommendation: Cervical Discectomy for Acute Radiculopathy*

**Cervical discectomy is not recommended for acute radiculopathy (under 4 week’s duration) unless objective evidence of a progressive neurological deficit or myelopathy is present.** Sufficient time for natural resolution and non-operative therapy is required. The excellent outcomes reported in the quality studies strongly suggest there is no need to rush surgery other than surgical emergencies.(361-364)

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

*Level of Confidence* – **Moderate**

3. *Recommendation: Discectomy for Acute, Subacute, or Chronic Cervical or Thoracic Spine Pain without Radiculopathy*  
**Discectomy is not recommended for treatment of acute, subacute, or chronic cervical pain or thoracic pain without radiculopathy.**

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

*Level of Confidence* – **High**

4. *Recommendation: Alternative Forms of Discectomy for Cervical or Thoracic Radicular Pain Syndrome*

**Percutaneous discectomy (nucleoplasty), laser discectomy, and disc coblation therapy are not recommended as treatment for any spine or radicular pain syndrome.**

## Rationale for Recommendations

There are no quality studies comparing discectomy with non-operative treatment, and non-operative resolution demonstrably occurs.(348, 1252, 1253) There are many methodological weaknesses in the existing literature, (1239) and not one single high-quality study has been identified for this area (see evidence table). The rapid pace of change in surgical technique and technologies has added additional major hurdles to have sufficient moderate- to high-quality studies that are technologically current. This literature analysis found most trials have major methodological issues generally including failures to report details on randomization processes, few data for evaluating between group baseline differences, lack of blinded assessors, nearly universal absence of recognition or controls on co-interventions, and some including lack of detailed reporting of dropout rates.

The available literature demonstrates moderate quality evidence of short to longer-term efficacy of nerve root decompression surgery for patients with radicular symptoms from disc herniation insufficiently responsive to non-operative treatment.(361-364, 1212, 1242, 1249-1251) Demonstrated favorable outcomes include marked improvements in radicular pain and work capacity.(361-364, 1249) Radicular pain due to a herniated intervertebral disc that does not decrease over a period of at least 6 weeks is thus considered a surgical indication for open discectomy and microdiscectomy.(361-364) However, because up to 75% of patients with radicular symptoms from herniated lumbar discs may become minimally symptomatic or asymptomatic without surgical intervention and there is no strong rationale or quality evidence of significant differences between the lumbar and cervical or thoracic spine, it is important to allow sufficient time to pass prior to consideration of surgery. (A population-based study found very low rates of thoracic spine surgery in Japan.(1217) A retrospective case series found few thoracic spine cases.(1218) A retrospective case series suggested most thoracic herniations, while rare, also do not require surgery (1209). Also, the evidence is strong that there is no need to rush patients into spine surgery in the absence of progressive neurological deficit, surgical emergencies, and catastrophic situations, as there is no quality evidence of differences in functional recovery whether the surgery is early or delayed, and there is quality evidence of spontaneous recoveries.(512) Discectomy is invasive, has complications and adverse effects (failure to improve, hoarseness, tongue paralysis, swallowing difficulty, Horner’s syndrome esophageal perforation and fistulae, spinal cord/root injury, and vertebral artery injury) (1239, 1254) and is costly; however in select patients, surgery is recommended.

The rare patient with muscle weakness or sensory deficit that gets progressively worse over serial physical examinations is a potential candidate for relatively immediate discectomy.(361-364) Upper extremity muscle weakness and sensory deficits that do not change on serial physical examination are not absolute indications for discectomy as the prognosis for recovery of strength and sensation depends of many factors other than surgery. While non-progressive weakness and sensory deficit are not absolute indications for surgery, many patients with significant functional impairment from cervical radiculopathy who have weakness and/or sensory deficit are candidates for discectomy.(361-364)

### 5. *Recommendation: Thoracic Discectomy for Subacute or Chronic Radiculopathy*

**Thoracic discectomy is recommended for treatment of patients with ongoing nerve root compression who continue to have significant pain and functional limitation after at least 3 months of time and appropriate non-operative therapy.**

The decision as to which type of discectomy procedure to perform should be left to the surgeon and the patient until quality evidence becomes available to provide evidence-based guidance.

*Indications* – All of the following present: 1) radicular pain syndrome with current dermatomal pain and/or numbness consistent with a herniated disc; 2) imaging findings by MRI, or CT with or without myelography that confirm persisting nerve root compression at the level and on the side predicted by the history and clinical examination; and 3) continued significant pain and functional limitation after at least 3 months of time and appropriate non-operative treatment.

*Strength of Evidence – Recommended, Insufficient Evidence (I)*  
*Level of Confidence – Low*

## Rationale for Recommendation

There are no quality studies on treatment of symptomatic herniated thoracic discs. However, the same indications are believed to be necessary for treatment of patients with these relatively less common issues. There is no significant muscle weakness problem with thoracic disc herniations. The issues are pain, and potentially spinal cord compression with leg spasticity and ataxia, and bowel or bladder control impairment. The current literature does not permit a conclusion that open

discectomy, microdiscectomy, or endoscopic discectomy should be the preferred procedure as there are no quality comparative trials for treatment of the cervical or thoracic spine. There is no quality evidence that automated percutaneous discectomy, laser discectomy, or coblation therapy is an effective treatment for any cervical or thoracic spine problem. There are no quality studies for this issue, which is relative uncommon. Patients who are candidates for discectomy should be informed that (other than likely for progressive neurological deficits and the rare progressive major neurologic deficit), there is evidence that there is no need to rush surgical decisions. The decision as to which type of discectomy procedure to perform should be left to the surgeon and the patient until quality evidence becomes available to provide evidence-based guidance.

## Evidence for the Use of Discectomy, Microdiscectomy, Sequestrectomy and Endoscopic Decompression

There are 17 moderate-quality (361-364, 860, 1223, 1224, 1242, 1249-1251, 1255-1260) RCTs incorporated into this analysis. There are 27 low-quality (643, 865, 1261-1285) RCTs and 4 other studies (1286-1289) in Appendix 1.

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*discectomy, microdiscectomy, microdiskectomy, micordiscectomies, microdiskectomies, sequestrectomy, sequestrectomies, endoscopy, endoscopic, decompression, endoscopic decompression, endoscopic decompressions, 'diskectomy, percutaneous', percutaneous diskectomy, percutaneous, nerve root decompression, nerve root decompressions, nerve root, thoracic discectomy, thoracic discectomies, thoracic diskectomies, thoracic, diskectomy, spinal fusion, autologous platelet gel, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies.*

*to find 3437 articles. Of the 3437 articles, we reviewed 3437 articles and included 74 articles (61 randomized controlled trials and 12 systematic reviews).*

## Decompressive Surgery For Spinal Stenosis (Laminoplasty, Laminectomy)

Spinal stenosis means insufficient room for neural elements in the spinal canal and/or neural foramina. It can be congenital (e.g., short pedicles) or acquired (degenerative enlargement of facets and ligaments and in addition the formation of osteophytes), or both. Stenosis can be in the central canal, in the lateral recess, or in the neural foramen. These degenerative changes are also referred to as cervical or thoracic spondylosis, although cervical stenosis is a more common term. The typical symptoms of cervical spinal stenosis are radiating pain into one or both upper limbs on movement of the neck. Patients may have symptoms and signs of multiple nerve root impingements, including dermatomal and myotomal findings. When the changes involve the cord and include findings such as spastic gait, ataxia, clonus, atrophy and incontinence, it is termed myelopathy.(335, 1244, 1256, 1290-1293) Cervical spinal stenosis when combined with lumbar stenosis may include symptoms of neurogenic claudication, or leg pain that develops during walking and that is promptly relieved by rest, although those symptoms are more typical of lumbar stenosis.(1294) Acquired cervical and thoracic spondylosis are natural aging phenomena with strong genetic components that may become symptomatic. Decompressive surgery for cervical spinal stenosis is infrequently performed in the US, as decompression combined with fusion is generally performed (see below). Decompressive surgery for thoracic spinal stenosis is infrequently performed due to the relatively uncommon occurrence of this condition, although decompression without fusion is more common in the thoracic spine than cervical spine.

Decompressive surgery for spinal stenosis involves techniques that remove bone from one or more structures to expand a narrowed spinal canal/neural foramen that impinges on neural structures. **Laminoplasty** involves freeing or partially freeing lamina without complete removal of the laminae. (1295-1304) **Foraminotomy** involves surgically opening the nerve root foramen, usually compressed due to degenerative osteophytes and disc changes.(1223) Percutaneous laminoforaminotomy can also be used.(1305) **Laminectomy** refers to the complete removal of the lamina. Unilateral laminotomy was traditionally performed as part of a discectomy, but is not generally performed any longer for sole treatment of cervical radiculopathy due to poorer outcomes in comparative studies, (1306) although not all authors report poor results and a skip laminectomy procedure has been reported.(1298, 1307) Laminectomy with posterior cervical plating has been developed to address the potential instability from laminectomy alone and has been utilized for treatment of posterior longitudinal ligament ossification.(1308) **Hemilaminectomy** refers to removal of the left half or the right half of the lamina. **Facetectomy** is removal

of part of or at times all of a facet joint. **Posterior decompression** is a term usually used to include any of the above surgeries for spinal stenosis. **Fusion** is frequently recommended at the same time as a spinal stenosis decompression. The fusion section of these guidelines should be consulted for the indications for spine fusion performed simultaneously with decompression.

Fusion has been more popular in the US and slightly higher rates of success have been reported for fusions compared with laminoplasty.(1306) Anterior cervical discectomy and fusion is the most commonly performed decompression procedure for cervical stenosis in the United States. Laminoplasty has been particularly utilized for neurological compromise thought to be due to ossification of the posterior longitudinal ligament.(1309-1311) Laminoplasty was developed after concerns about instability from laminectomy (1309, 1312) and there are various specific laminoplasty procedures.(1309, 1312) Laminoplasty has also been advocated for treatment of failed ACDF due to inadequate decompression.(1313) It has also been reportedly superior to laminectomy (1296) and long term studies suggest good results.(1314, 1315)

*Recommendation: Decompression Surgery for Spinal Stenosis*

**Decompression surgery is recommended for treatment of patients with symptomatic spinal stenosis that is intractable to non-operative management.**

*Indications* – All of the following should be present: 1) neurogenic symptoms (e.g., upper extremity pain on neck movement, upper or lower limb ataxia, etc.) or objective neurologic deficit from cervical spinal stenosis; 2) imaging findings, by MRI, or CT/myelogram that confirm the nerve roots and/or the spinal cord are compressed consistent with the neurological symptoms; and 3) lack of responsiveness or unsatisfactory response(s) to adequate non-operative treatment over a minimum 6 to 8 week period. (1223) Myelopathic changes are associated with worse outcomes prognoses.

*Benefits* – Relief of spinal stenosis-related symptoms.

*Harms* – Rare, but serious complications include infection, paralysis and death.

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

*Level of Confidence* – **Moderate**

## Rationale for Recommendation

There are no quality studies to provide evidence-based guidance on the effectiveness of decompressive surgery for cervical or thoracic spinal stenosis compared with other procedures. Thus, until quality evidence is available, the choice of surgical procedure for symptomatic spinal stenosis is to be decided by the surgeon and patient. One moderate quality study compared laminoplasty with skip laminectomy and found no differences.(1304) Another moderate-quality study found French door laminoplasty modestly superior to open door.(1316) There are no quality studies comparing one type of decompressive surgery with another. These procedures are effective for treatment of the lumbar spine (see Low Back Disorders Guideline). These procedures are invasive, have adverse effects, but may be less invasive than fusion and thus are recommended for select patients (see Spinal Fusion below).

## Evidence for the Use of Decompressive Surgery for Spinal Stenosis

There are 7 moderate-quality RCTs incorporated into this analysis. (1242, 1304, 1316-1320) There is 1 low-quality RCT(1321) and 2 other studies(1322, 1323) in Appendix 1.

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*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*: laminectomy, foraminotomy, laminoplasty, facetectomy, decompressive surgery, neck pain, cervicalgia, cervical pain, cervical, radiculopathy, radicular pain, postoperative neck pain, postoperative cervical pain, herniated disk, controlled clinical trial, controlled trails, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Nonexperimental Studies.*

*to find 1155 articles. Of the 1155 articles, we reviewed 1155 articles and included 30 articles (16 randomized controlled trials and 14 systematic reviews).*

## Spinal Fusion

Cervical fusion to treat symptomatic disc herniation (anterior cervical discectomy and fusion) and spinal stenosis are discussed above.(361-364, 512, 1242, 1249-1251, 1324-1335)

Cervical fusion involves the surgical fusion of one or more vertebral segments by inserting bone grafts (with or without instrumentation) so that the previously mobile involved segments heal together to form a single bone mass. A spinal motion segment consists of 2 adjacent vertebrae, the connecting ligaments, 2 facet joints, and the interposed disc– (the occiput - C1 level and the C1-C2 level do not have discs). The proposed goal of cervical fusion is similar to that in fusing other joints in the body – that instability and pain will be improved. However, quality studies document fusion is not a reliable indicator for resolution of pain.(361-364, 512, 1210, 1244, 1249-1251, 1256, 1290-1292, 1336-1355)

There are numerous methodological issues affecting the quality of the literature, particularly on non-radicular cervical pain indications for fusion. These methodological issues impair the ability to draw robust evidence-based conclusions.(1247, 1356) Many of these conflicts likely originate from the problem that case series tend to show benefits while subsequent RCTs may or may not support the original impressions from the uncontrolled or less well designed studies, although not all authors support this supposition.(1357)

Diagnoses for which fusion is felt to be indicated include unstable vertebral fractures, stenosis with myelopathy, recurrent radiculopathy, failed discectomy treatment, surgery for tumor, infection, or other disease processes with spinal motion segment instability. However, some surgeons perform cervical fusion for cases of axial cervical pain without radicular pain, and there are no quality studies identified to support surgery for those patients.(211, 402, 407, 410, 1356, 1358-1360)

*1. Recommendation: Cervical Discectomy with Fusion for Chronic Radiculopathy*

**Cervical discectomy with fusion is recommended for patients with chronic radiculopathy due to ongoing nerve root compression who continue to have significant pain and functional limitation after at least 6 months of time and appropriate non-operative treatment. The decision to use an anterior or posterior approach and what technique to achieve a fusion (which procedure) to use should be left to the surgeon.**

*Benefits* – Reduction in spine and extremity pain and neurological compromise if present.

*Harms* – Operative complications, rare severe outcomes (e.g., paralysis, fatalities), increased further re-operative risk, cost, increased risk of disability.

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

*Level of Confidence* – **Moderate**

*2. Recommendation: Decompression Surgery for Spinal Stenosis/Myelopathy*

**Decompression with fusion is recommended for treatment of patients with symptomatic spinal stenosis that is intractable to non-operative management. The decision to use an anterior or posterior approach and what technique to achieve a fusion should be left to the surgeon.**

*Benefits* – Reduction in spine and extremity pain and neurological compromise if present.

*Harms* – Operative complications, rare severe outcomes (e.g., paralysis, fatalities), increased further re-operative risk, cost, increased risk of disability.

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

*Level of Confidence* – **Moderate**

*3. Recommendation: Fusion for Degenerative Spondylolisthesis*

**Fusion is recommended for treatment of degenerative spondylolisthesis.**

*Benefits* – Reduction in spine and extremity pain and neurological compromise if present.

*Harms* – Operative complications, rare severe outcomes (e.g., paralysis, fatalities), increased further re-operative risk, cost, increased risk of disability.

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

*Level of Confidence* – **Moderate**

*4. Recommendation: Spinal Fusion with Simultaneous Discectomy*

**Spinal fusion is recommended as an option at the time of discectomy if a patient is having a simultaneous discectomy on the same disc.**

*Indications* – Meeting indications for a discectomy on the same disc.

*Benefits* – Theoretical reduced risk of later surgery on the same disc.

*Harms* – Longer recovery, greater rate of complications, higher costs.

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

*Level of Confidence* – **Low**

5. *Recommendation: Pulsed Electromagnetic Field Stimulation for Cervical Spine Fusion Patients*

**Pulsed electromagnetic field stimulation for cervical spine fusion is not recommended as a routine treatment for these patients, including patients with multiple spine fusion levels or in smokers.(1210)**

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

*Level of Confidence – Low*

6. *Recommendation: Autologous Platelet Gel for Cervical Spine Fusion Patients*

**Autologous platelet gel for cervical spine fusion is not recommended.(1354)**

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

*Level of Confidence – Low*

## **Rationale for Recommendations**

There are quality studies on fusion, although most are somewhat handicapped as they have heterogeneous populations of patients and insufficient sample sizes with which to assess differences between diagnostic entities. However, as considerable numbers of subjects often migrate out of the non-operative group assignments, a conclusion that there is no long term difference between surgery and non-operative management is currently unable to be supported with quality data.

There are no RCTs on patients with what are generally accepted as unequivocal indications for cervical fusion surgery such as unstable fracture, spinal infections, or tumors, and none on thoracic spine fusions. There are no quality studies of cervical or thoracic spondylolisthesis which are believed to be relatively uncommon, although there are a few in the lumbar spine. There are no quality RCTs using cervical fusion for either acute, subacute, or chronic non-specific cervical pain. Cervical fusion has been proposed as treatment for spondylolisthesis, disc herniation, spinal stenosis, and chronic non-specific cervical pain (also referred to as degenerative disc disease, discogenic cervical pain, micro instability, black disc disease, and cervical spondylosis).

The available quality studies suggest cervical fusion for radiculopathy results in improvements in arm pain more than cervical pain, because nerve root decompression is done at the time of fusion (see evidence table), thus fusion appears to be an option, although discectomy appears to be equally effective. (361-364, 1242, 1249-1251) One trial suggests fusion did not provide additive benefit to a rehabilitation program (1549). There is no quality evidence to evaluate cervical fusion for persisting upper extremity and/or cervical pain in those who have had a prior discectomy.

Chronic cervical pain patients can be extremely difficult to manage, particularly when the pain is severe, narcotic and other drug issues are present, adherence to exercise regimens is weak, psychosocial stressors are present, and coping skills are poor. Fusion is often viewed as one of the last resort options for treatment of these individuals. Similarly, patients often come to view these surgical procedures as potential cures. However, there are no quality studies documenting improved results with fusion compared with other treatments including non-operative treatments for these patients.

Pulsed electromagnetic field stimulation has been used to increase radiological fusion rates in high risk patients, particularly including fusion of multiple levels or in smokers (who are more likely to have non-unions than are non-smokers).(1210) However, a large, moderate quality study found that while there was increased fusion in these patients at 6 months, there were no differences at 12 months and there were no differences at any point in clinical outcomes, thus this treatment is not recommended. This treatment may still have some value, however the patient population would seem to be those with an extremely high risk of nonunion where PEMF is thought to be helpful and there is no quality study currently available and supportive among such a small, highly defined patient population.

Autologous platelet gel has been proposed to increase radiological fusion rates in ACDF patients;(1354) however, a moderate quality, double-blinded study found no differences in intermediate to long term fusion rates or clinical outcomes, thus, this treatment is not recommended.

Cervical fusion is among the more invasive of the commonly performed spine surgeries. It is high cost and has significant risks of complications. However, for a select few chronic radicular pain patients, particularly those who have recurrence after discectomy, it may be recommended.

## Evidence for the Use of Spinal Fusion

There are 36 moderate-quality RCTs (two with multiple reports) incorporated into this analysis.(361-364, 512, 860, 1210, 1224, 1244, 1249-1251, 1256, 1257, 1259, 1290-1292, 1336-1352, 1354, 1361-1365) There are 16 low-quality RCTs(643, 865, 1266, 1275-1277, 1279-1281, 1284, 1285, 1321, 1353, 1366-1368) in Appendix 1.

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*discectomy, microdiscectomy, microdiskectomy, micordisectomies, microdiskectomies, sequestrectomy, sequestrectomies, endoscopy, endoscopic, decompression, endoscopic decompression, endoscopic decompressions, 'diskectomy, percutaneous', percutaneous diskectomy, percutaneous, nerve root decompression, nerve root decompressions, nerve root, thoracic discectomy, thoracic discectomies, thoracic diskectomies, thoracic, diskectomy, spinal fusion, autologous platelet gel, cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. to find 1740 articles. Of the 1740 articles, we reviewed 1740 articles and included 119 articles (90 randomized controlled trials and 29 systematic reviews).*

## Non-specific Chronic Cervical Pain: Cervical Fusions

The terms “degenerative disc disease,” “discogenic cervical pain,” “black disc disease,” “micro instability,” and “cervical spondylosis” are used interchangeably to describe the same group of patients with chronic cervical pain in whom the pain generating structure is not defined. Discography has been used to attempt to define the neck disc as the pain source, although without studies showing a change in outcome (no construct validity). Chronic cervical pain is complex and can be difficult to treat. Current surgical treatment modalities are controversial. Since there is no reliable method to identify the source of a patient’s pain, surgery for pain is unlikely to be helpful.

There is no comparable study in the neck, but higher quality studies of non-specific low back pain treatments found fusion failed to improve the outcomes seen with either cognitive intervention and exercise or an intensive rehabilitation program in two different populations studied.(1369-1371) There is no clear reason to expect differences in the neck if similar studies were conducted.

The effects of workers’ compensation on fusion patients suggests workers’ compensation conveys a worse prognosis in the cervical spine,(1212, 1372-1383) as it also does in the lumbar spine (427, 1384, 1385) In summary, cervical fusion does not have clear evidence of efficacy for chronic non-specific cervical pain. It has a significant rate of serious complications, and is high cost.

*Recommendation: Cervical or Thoracic Fusion for Chronic Non-specific Cervical or Thoracic Pain*

**Cervical fusion is not recommended for chronic non-specific cervical or thoracic pain.**

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

*Level of Confidence – Moderate*

## Rationale for Recommendation

There are no quality trials comparing fusion with either a quality functional restoration program or with non-operative treatment for management of chronic non-specific cervical pain. Chronic back pain has been shown to have comparable outcomes at one year with either fusion or a quality rehabilitation program.(1370) Thus, the same results could be expected in the cervical or thoracic spine. There is controversy in the medical literature about the definition of proven spinal instability. The Evidence-based Practice Cervical and Thoracic Spine Panel recognizes the controversy (1386) and recommends the following definition be used with flexion-extension bending films done standing with a 72 inch tube to film distance: These films should be taken digitally, and a CD with the films and the software to permit viewing and computer measurement of the translation distance should be retained and kept available for review. The first criterion would be  $\geq 4$  mm of translation of the superior vertebral body on the inferior body from the full extension film to the full flexion films. The other criterion would be



having a total angular movement during flexion and extension at the unstable level that is at least 12 degrees greater than the motion present at an adjacent disc.(1387)

## Disc Replacement

Cervical disc replacements have been developed as an alternative to fusion for treatment of intractable radiculopathy and myelopathy patients (see evidence table).(1258, 1260, 1335, 1388-1396) An argument used to support disc replacement surgery is that it allows more natural movement of the vertebral segments, thus reducing biomechanical forces on the neighboring segment and presumably reducing the risk of adjacent segments becoming clinically diseased.(1397) A comparative study found no differences in kinematics.(1398) The term “adjacent segment disease” is used to describe patients with degenerative changes (that are presumed to be painful) at the spinal level above or below a spinal motion segment that has been treated, for example by spinal fusion. Disc replacement has also been reportedly used to treat adjacent level disc disease.(1399)

### 1. Recommendation: Disc Replacement for Subacute or Chronic Cervical Radiculopathy or Myelopathy

**Artificial disc replacement is moderately recommended as a treatment for subacute or chronic radiculopathy or myelopathy.**

*Indications* – Select patients with symptomatic cervical radiculopathy with or without myelopathy that is resistant to at least 6 weeks of non-operative care.(361, 362, 1400) Symptoms should have a consistent dermatomal or myotomal pattern. MRI, CT or myelogram findings should correlate with clinical findings. Patients should be thought to be better candidates for this procedure than simple discectomy or traditional anterior cervical discectomy and fusion (see evidence table). **Caution should be noted particularly for surgery in younger workers as there are few reports of long-term follow-up (10 to 20 years) after this surgery.**<sup>xvi</sup>

*Benefits* – Reduction in neck pain and neurological compromise. Somewhat faster recovery than with fusion surgery.

*Harms* – Operative complications, rare severe outcomes (e.g., paralysis, fatalities), increased further re-operative risk, cost, increased risk of disability.

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

*Level of Confidence* – **Moderate**

### 2. Recommendation: Disc Replacement for Chronic Non-specific Cervical Pain

**Disc replacement is not recommended as a treatment for chronic non-specific cervical pain or other spinal pain syndrome.**

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

*Level of Confidence* – **Moderate**

## Rationale for Recommendations

There are quality studies of short to intermediate term durations of up to 7 years for treatment of cervical radiculopathy or myelopathy patients (see evidence table). However, there are no quality trials comparing disc replacement with non-operative treatments, particularly including a quality rehabilitation program. All 4 of the highest quality studies document superiority of the disc replacement over fusion particularly in the first 3 months, and at least one study documented trends towards earlier return to work in the disc replacement group.(1401) However, there are no quality studies comparing disc replacement with either simple discectomy or non-operative treatments. A few trials included two-levels with disc replacement, but not more than two levels. Cervical disc replacement is invasive, has adverse effects, is costly, but trends towards faster recovery and studies have now been reported out to 3 years of follow-up sufficient to warrant a recommendation for consideration of this treatment for select patients. In all published series and RCTs the indications for cervical disc replacement surgery were patients who were candidates for discectomy or anterior discectomy and fusion for radiculopathy with or without myelopathy, and not patients with non-specific cervical pain. Additional research including demonstrated long-term safety and efficacy would be needed prior to a recommendation in support.

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<sup>xvi</sup>A case report by Devin et al of a lumbar disc replacement patient who at age 30 was reported in a case series as having a “good” early post-operative result, but at age 50 was reported to have total mechanical failure of the implant and a difficult salvage surgery is concerning when considering disc replacement in young individuals with long predicted life expectancies. The authors state this case is the longest published follow up of a lumbar disc replacement patient.

## Evidence for the Use of Disc Replacement

There are 17 moderate-quality RCTs (two with multiple reports) (1258-1260, 1320, 1389-1393, 1397, 1401-1414) incorporated into this analysis. There are 9 low-quality RCTs(643, 1278, 1281, 1282, 1284, 1285, 1415-1417) and 9 other studies(1287, 1289, 1418-1424) in Appendix 1.

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*Disc Replacement, Total Disc Replacement, replacement and replantation, disorder terms-cervicalgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly; systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, and Non-experimental Studies.*

*to find 857 articles. Of the 857 articles, we reviewed 857 articles and included 42 articles (37 randomized controlled trials and 5 systematic reviews).*

## Vertebroplasty

Vertebroplasty, first reported in 1987, (1425) involves using imaging guidance to inject polymethylmethacrylate within the vertebral body, in order to stabilize vertebral fractures caused by osteoporosis, vertebral osteonecrosis, or malignancies of the spinal column.(1426-1434) This procedure is most common among elderly osteoporotic patients who have delayed healing of compression fractures of the vertebral body(ies),(1435) but it is sometimes performed on younger patients with acute vertebral fractures due to osteoporosis. A work-related minor trauma may be the event that caused the osteoporotic pathologic fracture.

1. *Recommendation: Vertebroplasty for Cervical or Thoracic Pain Due to Vertebral Compression Fractures*  
**Vertebroplasty is not recommended as a routine treatment for patients with cervical or thoracic pain due to vertebral compression fractures.**(1436, 1437)

*Strength of Evidence – Strongly Not Recommended, Evidence (A) [Subacute, Chronic]*

*Level of Confidence – High*

*Strength of Evidence – Not Recommended, Evidence (C) [Acute]*

*Level of Confidence – Moderate*

2. *Recommendation: Vertebroplasty for Select Patients with Cervical or Thoracic Pain Due to Vertebral Compression Fractures*

**There is no recommendation for or against the use of vertebroplasty for treatment of highly select patients with cervical or thoracic pain due to unusual vertebral compression fractures.**

*Indications – Patients who are not included in the two available high-quality trials. These include patients who have had fractures despite bisphosphonate therapy, pathologic fractures due to neoplasms in the vertebral body, or multiple simultaneous compression fractures (three or more). Candidates for vertebroplasty should have these types of unusual vertebral body compression fractures, should generally have severe pain, passage of at least 2 months, and failure of other treatment options including medical management.*

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

*Level of Confidence – Low*

## Rationale for Recommendations

There are two recent high-quality, sham-controlled RCTs available that evaluated the efficacy of vertebroplasty and both failed to find any significant improvements in the patients who underwent vertebroplasty compared with a sham procedure.(1436, 1437) Both trials included patients with thoracic fractures. These results are in contrast with other low-quality studies that had reported pain relief and other functional improvements that had appeared promising.(1429, 1433, 1434, 1438-1444) Carragee's review chronicles how the apparent benefit of this procedure disappeared as low-quality

evidence (case series) was replaced by high quality evidence RCTs.(1445) There is one other quality trial which reported pain relief and increased mobility; however, that trial is of lower quality, was short (2 weeks), and had a substantially lower sample size than the recent studies, and appears biased against pain treatment. In addition, substantial complications occur with this procedure including deaths.(1429, 1436, 1446-1449) The results of these high quality trials have not been universally supported.(1450)

The results of the two high-quality RCTs indicate that vertebroplasty is strongly not recommended for nearly all patients with vertebral compression fractures. It remains unclear whether there are selected unusual patients – such as severely affected patients, patients with 3 or more simultaneous compression fractures, or patients with pathologic fractures due to neoplasms (1433) – who were outside the scope of these two quality trials, who might still derive benefit from this procedure. This procedure is invasive, has complications,(1451, 1452) and is costly. Therefore, vertebroplasty is not recommended other than for select patients who have failed other interventions (including quality medical management) and for whom there are no other options available, whose significant pain is not resolving, and especially those for whom bisphosphonate therapy has failed.

## Evidence for the Use of Vertebroplasty

There are 2 high-(1436, 1437) and 2 moderate-quality(1453, 1454) RCTs incorporated into this analysis.

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*Vertebroplasty, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. to find 1162 articles. Of the 1162 articles, we reviewed 1162 articles and included 7 articles (4 randomized controlled trials and 3 systematic reviews).*

## Kyphoplasty

Kyphoplasty, first introduced in 1998, has been used similarly to vertebroplasty to restore vertebral body height and improve sagittal alignment of the spine.(1433, 1434, 1455, 1456) Kyphoplasty involves injection of polymethylmethacrylate within a cavity in the vertebral body that has been created by percutaneous insertion of a balloon through the involved pedicle(s).(1433, 1434, 1457)

*Recommendation: Kyphoplasty for Cervical and Thoracic Pain Due to Vertebral Compression Fractures*

**There is no recommendation for or against the use of kyphoplasty as a treatment for patients with cervical or thoracic pain due to vertebral compression fractures.**

*Indications* – Vertebral body compression fractures among patients with severe pain; patients who have had fractures despite bisphosphonate therapy may be candidates.

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

*Level of Confidence* – **Low**

## Rationale for Recommendation

There are no quality randomized controlled trials comparing kyphoplasty with a sham procedure. There is one moderate-quality study comparing kyphoplasty with an unstructured, unblinded non-interventional control that included cancer patients.(1458) That study also differentially utilized passive treatments between the two groups, such as bed rest and braces, and that may have confounded the results. The other moderate-quality study compared two types of cement and found the calcium phosphate cement to be inferior for burst fractures.(1457) There are other non-randomized comparative clinical trials and other low-quality studies suggesting benefit.(1433, 1459-1461) These have been compiled into meta-analyses with a conclusion of efficacy (as well as efficacy of vertebroplasty) that have been supported by others.(1433, 1434, 1462-1464) Yet, as kyphoplasty is similar to vertebroplasty, and two high-quality sham-controlled trials for vertebroplasty are

now reported documenting a lack of benefit, (1436, 1437) and despite the Wardlaw study which included patients with neoplasia, it appears reasonable to assume the same lack of benefit will eventually be shown for kyphoplasty for treatment of non-cancer patients. It remains unclear whether there are selected patients such as those severely affected, patients with 3 or more simultaneous compression fractures, or patients with pathologic fractures due to neoplasms, (1433) who may derive benefit from this procedure. Kyphoplasty is invasive, has complications, and is costly. There is no recommendation for or against kyphoplasty other than highly selected patients who failed other interventions (including quality medical management), and in whom there are no other options available, whose significant pain is not resolving, and especially those for whom bisphosphonate therapy has failed. A systematic review found kyphoplasty patients to have outcomes and pain reduction compared to patients receiving conservative treatment. (1465)

## Evidence for the Use of Kyphoplasty

There are 2 moderate-quality RCTs incorporated into this analysis. (1457, 1458) There is 1 low-quality RCT in Appendix 1. (1466)

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*kyphoplasty, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated, herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies. to find 1125 articles. Of the 1125 articles, we reviewed 1125 articles and included 2 articles (2 randomized controlled trials and 0 systematic reviews).*

## Cervical Spinal Cord Stimulators

Spinal cord stimulators (SCS) deliver electrical impulses to the spinal cord area through electrodes that are implanted in the epidural space. (1467, 1468) While most commonly utilized in the lumbar spine, they are utilized for treatment of the cervical spine for chronic cervicothoracic spinal pain patients with or without radiculopathy.

**Recommendation: Spinal Cord Stimulators for Treatment of Chronic Cervicothoracic Pain with or without Radiculopathy**  
**Spinal cord stimulators are not recommended for chronic cervicothoracic pain with or without radiculopathy.**

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

*Level of Confidence – Low*

## Rationale for Recommendation

There are no quality trials of SCS in cervicothoracic pain with or without radiculopathy. There is one case series of cervical SCSs in only 5 chronic cervicothoracic pain patients who had failed to improve with conservative therapies and cervical fusion surgeries. Eighty-percent of the patients indicated at least 50% pain reduction during a trial implantation lasting 5 to 7 days. After implantation, follow-up ranged from 1 to 9 months in 4 patients. They reported pain relief of >50% at 6 months. They did not report any serious adverse events during their follow-up period. (1468) (See Low Back Disorders and Chronic Pain guidelines for discussion of spinal cord stimulators.) SCS are invasive, have high adverse effects, and are high cost. They are not recommended for treatment of cervicothoracic pain with or without radiculopathy.

## Evidence for the Use of Cervical Spinal Cord Stimulators

There are no quality studies incorporated into this analysis.

*We searched PubMed, EBSCO, Google Scholar, and Cochrane Review with no limits on publication dates and then an updated search was conducted using PubMed for publications between 1/1/2013 and 11/15/2017. We used the following search terms:*

*spinal cord stimulation, spinal stimulation, spinal cord stimulators, cervicgia, neck pain, cervical pain, neck, cervical, vertebrae, vertebral, spine, radiculopathy, radiculopathies, radicular pain, intervertebral disc displacement, herniated,*

*herniat\*, displacement, displacements, displaced, disk, disc, disks, discs, pain, controlled clinical trial, controlled trials, randomized controlled trial, randomized controlled trials, random allocation, random\*, randomized, randomization, randomly, systematic, systematic review, retrospective studies, prospective studies, epidemiological studies, epidemiological research, Nonexperimental Studies.*  
to find 2475 articles. Of the 2475 articles, we reviewed 2475 articles and included 0 articles (0 randomized controlled trials and 0 systematic reviews).

## Rehabilitation for Delayed Recovery

SEE [CHRONIC PAIN GUIDELINE](#) FOR RECOMMENDATIONS ON THE FOLLOWING:

- [WORK CONDITIONING, WORK HARDENING, EARLY INTERVENTION PROGRAMS AND BACK SCHOOLS FOR CHRONIC PAIN](#)
- [TERTIARY PAIN PROGRAMS: INTERDISCIPLINARY PAIN REHABILITATION PROGRAMS, MULTIDISCIPLINARY REHABILITATION PROGRAMS, CHRONIC PAIN MANAGEMENT PROGRAMS, AND FUNCTIONAL RESTORATION PROGRAMS](#)
- [PSYCHOLOGICAL EVALUATION FOR CHRONIC PAIN PATIENTS](#)
- [COGNITIVE BEHAVIORAL THERAPY FOR PATIENTS WITH CHRONIC PAIN](#)
- [FEAR AVOIDANCE BELIEF TRAINING](#)
- [BIOFEEDBACK](#)

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