

RULE 17, EXHIBIT 5

# Cumulative Trauma Conditions Medical Treatment Guidelines

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**DIVISION OF WORKERS' COMPENSATION**



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# DEPARTMENT OF LABOR AND EMPLOYMENT

## Division of Workers' Compensation

CCR 1101-3

Rule 17, EXHIBIT 5

### **CUMULATIVE TRAUMA CONDITIONS MEDICAL TREATMENT GUIDELINES**

#### **A. INTRODUCTION**

This document has been prepared by the Colorado Department of Labor and Employment, Division of Workers' Compensation (Division) and should be interpreted within the context of guidelines for physicians/providers treating individuals qualifying under Colorado's Workers' Compensation Act as injured workers with cumulative trauma conditions.

Although the primary purpose of this document is advisory and educational, these guidelines are enforceable under the Workers' Compensation Rules of Procedure, 7 CCR 1101-3. The Division recognizes that acceptable medical practice may include deviations from these guidelines, as individual cases dictate. Therefore, these guidelines are not relevant as evidence of a provider's legal standard of professional care.

To properly utilize this document, the reader should not skip nor overlook any sections.

## B. GENERAL GUIDELINES PRINCIPLES

The principles summarized in this section are key to the intended implementation of all Division of Workers' Compensation guidelines and critical to the reader's application of the guidelines in this document.

1. **APPLICATION OF THE GUIDELINES:** The Division provides procedures to implement medical treatment guidelines and to foster communication to resolve disputes among the provider, payer, and patient through the Workers' Compensation Rules of Procedure. In lieu of more costly litigation, parties may wish to seek administrative dispute resolution services through the Division or the Office of Administrative Courts.
2. **EDUCATION:** Education of the patient and family, as well as the employer, insurer, policy makers, and the community should be the primary emphasis in the treatment of chronic pain and disability. Currently, practitioners often think of education last, after medications, manual therapy, and surgery. Practitioners must implement strategies to educate patients, employers, insurance systems, policy makers, and the community as a whole. An education-based paradigm should always start with inexpensive communication providing reassuring and evidence-based information to the patient. More in-depth patient education is currently a component of treatment regimens which employ functional, restorative, preventive, and rehabilitative programs. No treatment plan is complete without addressing issues of individual and/or group patient education as a means of facilitating self-management of symptoms and prevention.
3. **INFORMED DECISION MAKING:** Providers should implement informed decision making as a crucial element of a successful treatment plan. Patients, with the assistance of their health care practitioners, should identify their personal and professional functional goals of treatment at the first visit. Progress towards the individual's identified functional goals should be addressed by all members of the health care team at subsequent visits and throughout the established treatment plan. Nurse case managers, physical therapists, and other members of the health care team play an integral role in informed decision making and achievement of functional goals. Patient education and informed decision making should facilitate self-management of symptoms and prevention of further injury.
4. **TREATMENT PARAMETER DURATION:** Time frames for specific interventions commence once treatments have been initiated, not on the date of injury. Obviously, duration will be impacted by patient compliance, as well as availability of services. Clinical judgment may substantiate the need to accelerate or decelerate the time frames discussed in this document.

5. **ACTIVE INTERVENTIONS**: Emphasizing patient responsibility, such as therapeutic exercise and/or functional treatment, is generally emphasized over passive modalities, especially as treatment progresses. Generally, passive interventions facilitate progress in an active rehabilitation program with concomitant attainment of objective functional gains.
6. **ACTIVE THERAPEUTIC EXERCISE PROGRAM**: Goals should incorporate patient strength, endurance, flexibility, coordination, and education. This includes functional application in vocational or community settings.
7. **POSITIVE PATIENT RESPONSE**: Results are defined primarily as functional gains that can be objectively measured. Objective functional gains include, but are not limited to, positional tolerances, range-of-motion (ROM), strength, endurance, activities of daily living (ADL), cognition, psychological behavior, and quantifiable efficiency/velocity measures. Subjective reports of pain and function should be considered and given relative weight when the pain has anatomic and physiologic correlation. Anatomic correlation must be based on objective findings.
8. **RE-EVALUATE TREATMENT EVERY 3 TO 4 WEEKS**: If a given treatment or modality is not producing positive results within three to four weeks, the treatment should be either modified or discontinued. Before discontinuing the treatment, the provider should have a detailed discussion with the patient to determine the reason for failure to produce positive results. Reconsideration of diagnosis should also occur in the event of a poor response to a seemingly rational intervention.
9. **SURGICAL INTERVENTIONS**: Surgical interventions should be contemplated within the context of expected functional outcome and not purely for the purpose of pain relief. The concept of "cure" with respect to surgical treatment by itself is generally a misnomer. All operative interventions must be based upon positive correlation of clinical findings, clinical course, and diagnostic tests. A comprehensive assimilation of these factors must lead to a specific diagnosis with positive identification of pathologic condition(s).
10. **SIX-MONTH TIME FRAME**: The prognosis drops precipitously for returning an injured worker to work once he/she has been temporarily totally disabled for more than six months. The emphasis within these guidelines is to move patients along a continuum of care and return to work within a six-month time frame, whenever possible. It is important to note that time frames may not be pertinent to injuries that do not involve work-time loss or are not occupationally related.

11. **RETURN-TO-WORK:** A return-to-work is therapeutic, assuming the work is not likely to aggravate the basic problem or increase long-term pain. The practitioner must provide specific physical limitations, and the patient should never be released to non-specific and vague descriptions such as “sedentary” or “light duty.” The following physical limitations should be considered and modified as recommended: lifting, pushing, pulling, crouching, walking, using stairs, bending at the waist, awkward and/or sustained postures, tolerance for sitting or standing, hot and cold environments, data entry and other repetitive motion tasks, sustained grip, tool usage, and vibration factors. Even if there is residual chronic pain, return-to-work is not necessarily contraindicated.

The practitioner should understand all of the physical demands of the patient’s job position before returning the patient to full duty and should request clarification of the patient’s job duties. Clarification should be obtained from the employer or, if necessary, from including, but not limited to, an occupational health nurse, occupational therapist, vocational rehabilitation specialist, an industrial hygienist, or another professional.

12. **DELAYED RECOVERY:** Strongly consider a psychological evaluation, if not previously provided, as well as initiating interdisciplinary rehabilitation treatment and vocational goal setting, for those patients who are failing to make expected progress 6 to 12 weeks after an injury. The Division recognizes that 3 to 10% of all industrially injured patients will not recover within the timelines outlined in this document, despite optimal care. Such individuals may require treatments beyond the timelines discussed within this document, but such treatment requires clear documentation by the authorized treating practitioner focusing on objective functional gains afforded by further treatment and impact upon prognosis.

13. **GUIDELINES RECOMMENDATIONS AND INCLUSION OF MEDICAL EVIDENCE:** *All recommendations are based on available evidence and/or consensus judgment.* When possible, guideline recommendations will note the level of evidence supporting the treatment recommendation. It is generally recognized that early reports of a positive treatment effect are frequently weakened or overturned by subsequent research. When interpreting medical evidence statements in the guideline, the following apply:

- Consensus means the judgment of experienced professionals based on general medical principles. Consensus recommendations are designated in the guidelines as “generally well-accepted,” “generally accepted,” “acceptable/accepted,” or “well-established.”
- “Some evidence” means the recommendation considered at least one adequate scientific study, which reported that a treatment was effective. The Division recognizes that further research is likely to have an impact on the intervention’s effect.
- “Good evidence” means the recommendation considered the availability of multiple adequate scientific studies or at least one relevant high-quality scientific

study, which reported that a treatment was effective. The Division recognizes that further research may have an impact on the intervention's effect.

- “Strong evidence” means the recommendation considered the availability of multiple relevant and high-quality scientific studies, which arrived at similar conclusions about the effectiveness of a treatment. The Division recognizes that further research is unlikely to have an important impact on the intervention's effect.

All recommendations in the guideline are considered to represent reasonable care in appropriately selected cases, irrespective of the level of evidence or consensus statement attached to them. Those procedures considered inappropriate, unreasonable, or unnecessary are designated in the guideline as “*not recommended*.”

14. **CARE BEYOND MAXIMUM MEDICAL IMPROVEMENT (MMI)**: MMI should be declared when a patient's condition has plateaued to the point where the authorized treating physician no longer believes further medical intervention is likely to result in improved function. However, some patients may require treatment after MMI has been declared in order to maintain their functional state. The recommendations in this guideline are for pre-MMI care and are not intended to limit post-MMI treatment. The remainder of this document should be interpreted within the parameters of these guidelines principles that may lead to more optimal medical and functional outcomes for injured workers.

REFERENCED

## C. DEFINITIONS AND MECHANISMS OF INJURY

Cumulative trauma related conditions (CTC) of the upper extremity comprise a heterogeneous group of diagnoses which include numerous specific clinical entities including disorders of the muscles, tendons and tendon sheaths, nerves, joints and neurovascular structures ([Walker-Bone & Cooper, 2005](#)).

The terms “cumulative trauma disorder”, “repetitive motion syndrome”, “repetitive strain injury”, “myofascial pain” and other similar nomenclatures are umbrella terms that are not acceptable, specific diagnoses. The health care provider must provide specific diagnoses in order to appropriately educate, evaluate, and treat the patient. Examples include: de Quervain’s disease, cubital tunnel syndrome, and lateral/medial epicondylitis (epicondylalgia). Many patients present with more than one diagnosis, which requires a thorough upper extremity and cervical evaluation by the health care provider. Furthermore, there must be a causal relationship between work activities and the diagnosis (See Section D.3 Initial Diagnostic Procedures, Medical Causation Assessment). The mere presence of a diagnosis that may be associated with cumulative trauma does not presume work-relatedness unless the appropriate work exposure is present.

Mechanisms of injury for the development of cumulative trauma related conditions have been controversial. However, repetitive awkward posture, force, vibration, cold exposure, and combinations thereof are generally accepted as occupational risk factors for the development of cumulative trauma related conditions.

Evaluation of cumulative trauma related conditions require an integrated approach that may include ergonomics assessment, clinical assessment, past medical history and psychosocial evaluation on a case-by-case basis.

The normal working age population may have non-specific pain complaints that require minimum treatment and may be considered part of the normal aging process. When pain continues or a complete history indicates a potential for other diagnoses, a medical workup may be necessary to screen for other diseases ([Walker-Bone & Cooper, 2005](#)). However, in cases where there is no specific diagnosis and corresponding work related etiology, the work-up should generally be performed outside of the workers’ compensation system.

## D. INITIAL DIAGNOSTIC PROCEDURES

The Division recommends the following diagnostic procedures be considered, at least initially, the responsibility of the workers' compensation carrier to ensure that an accurate diagnosis and treatment plan can be established. Standard procedures that should be utilized when initially diagnosing a work-related upper extremity complaint are listed below.

### 1. HISTORY-TAKING AND PHYSICAL EXAMINATION (HX & PE)

History-taking and physical examination are generally accepted, well-established and widely used procedures that establish the foundation for subsequent stages of diagnostic and therapeutic procedures. When findings of clinical evaluations and those of other diagnostic procedures are not complementing each other, the objective clinical findings should have preference. The medical records should reasonably document the following:

#### a. History of Present Injury

- i. Age, hand dominance, and gender should be documented.
- ii. Onset: date of onset, triggering event (if present) versus gradual onset. Activity at or before onset of symptoms.
- iii. Nature of symptoms: pain, numbness, tingling, weakness, swelling, stiffness, temperature change, moisture change, and color change.
- iv. Functional Assessment: Functional ability should be assessed and documented at the beginning of treatment. Periodic assessment should be recorded throughout the course of care to follow the trajectory of recovery. Functional measures are likely to be more reliable over time than pain measures.

Patient-reported outcomes, whether of pain or function, are susceptible to a phenomenon called response shift. Response shift refers to changes in self-evaluation, which may accompany changes in health status. Patient self-reports may not coincide with objective measures of outcome, due to reconceptualization of the impact of pain on daily function and internal recalibration of pain scales ([Schwartz & Finkelstein, 2009](#)). Response shift may obscure treatment effects in clinical trials and clinical practice, and it may lead to apparent discrepancies in patient-reported outcomes following treatment interventions. While methods of measuring and accounting for response shift are not yet fully developed, understanding that the phenomenon exists can help clinicians understand what is happening when some measures of patient progress appear inconsistent with other measures of progress.



- v. Pain: any history of pain, intermittent or constant, and intensity. A pain scale (0 = no pain, and 10 = worst imaginable pain) may be used. The use of a patient completed pain drawing, Visual Analog Scale (VAS) is highly recommended, especially during the first 2 weeks following injury to assure that all work related symptoms are addressed. Use comprehensive pain diagrams as it is important to solicit the reporting of more proximal symptoms. Evaluate the patient's overall pain behavior. The behavior should be consistent with the current pain levels reported by the patient. Pain assessments should include a description of functional activity performed by the patient at various pain levels.
- vi. Provocative and alleviating factors (occupational and non-occupational): Identify the specific physical factors that are aggravating or alleviating the problem. Include the patient's perception of cause of symptoms.
- vii. Sleep disturbances secondary to the condition including sleeping posture.
- viii. Other associated signs and symptoms noted by the injured worker.
- ix. Ability to perform activities of daily living (ADLs): ADLs include such activities as self-care and personal hygiene, communication, ambulation, attaining all normal living postures, travel, non-specialized hand activities, sexual function, sleep, and social and recreational activities. Specific movements in this category include: pinching or grasping keys/pens/other small objects (brushing teeth, doing laundry), grasping cups or other similar-sized objects, and opening jars. The quality of these activities is judged by the independence, appropriateness, and effectiveness with which they are completed. Assess not simply the number of restricted activities but the overall degree of restriction or combination of restrictions.
- x. Prior occupational and non-occupational injuries to the same area including specific prior treatment and any prior supportive devices.
- xi. Discussion of any symptoms present in the uninjured extremity or similar symptoms in the lower extremities.
- xii. Patient's expectation of recovery and return to work.

**b. Relationship to Work and Other Activity**

Assess the individual's ability to perform job duties. This frequently includes a job site evaluation including an ergonomic assessment as well as the patient's description of the job duties. Job title alone is not sufficient information. The

clinician is responsible for documenting specific information regarding repetition, force, other risk factors, and duration of employment. Refer to risk factors as listed in Section D.3.d Risk Factors Definitions Table and Section D.3.e Diagnosis-Based Risk Factors Table. A formal job site evaluation may be necessary. A formal job site evaluation may not be necessary when the physician is intimately familiar with the job position and associated work activities and there are no new job alterations.

Information should be obtained regarding other employment, sports, recreational, and avocational activities that might contribute to or be impacted by the cumulative trauma condition. Activities such as video gaming, smartphone use, crocheting/needlepoint, baseball/softball, playing musical instruments, home computer operation, golf, tennis, and gardening are included in this category. Duration of these activities should be documented. In most cases, the duration of these activities will be less than three hours per day, the minimum necessary to meet the causation standard. Therefore, these activities will not be considered major contributions to the medical condition.

Behavioral adaptations to symptoms should be documented.

**c. Past History**

- i. Demographics.
- ii. Past injury/symptoms involving the upper extremities, trunk and cervical spine.
- iii. Past work-related injury or occupational disease.
- iv. Past personal injury or disease that resulted in temporary or permanent job limitation.
- v. Medical conditions associated with cumulative trauma: The following are examples of medical conditions which have been commonly seen in association with cumulative trauma conditions. These require treatment and may impact the recovery of the work comp injury ([Atcheson, Ward, & Lowe, 1998](#)).
  - A) Amyloidosis;
  - B) Arthropathies, including connective tissue disorders, rheumatoid arthritis, systemic lupus erythematosus, gout, osteoarthritis and spondyloarthropathy;
  - C) Cancer;

- D) Diabetes mellitus, including family history or gestational diabetes;
  - E) Hypothyroidism, especially in older females;
  - F) Obesity;
  - G) Pregnancy;
  - H) Depression.
- vi. History of smoking and alcohol use; history of substance abuse;
  - vii. Medication history including, birth control pills, corticosteroid use, and other prescription and non-prescription medications; and
  - viii. Psychosocial history (including history of hobbies and recreational activities).

**d. Physical Examination**

The evaluation of any upper extremity complaint should begin at the neck and upper back and then proceed down to the fingers and include the contralateral region. It should include evaluation of vascular and neurologic status, and describe any dystrophic changes or variation in skin color or turgor. A description of the patient's general posture (e.g., neck rotation, shoulder depression, spine kyphosis), and body mass index [BMI] should be documented. Additional physical exam components may be necessary based on past medical history.

A neurological examination typically includes bilateral assessments of pinprick, 2 point sensation as applicable, motor strength and reflexes. These assessments of the upper extremities including a vascular assessment will provide information regarding polyneuropathic processes such as diabetic neuropathy. Vibratory sense and Achilles reflexes are frequently lost in diabetic neuropathy ([Moghtaderi, Bakhshipour, & Rashidi, 2006](#)). Decreased response to cold temperature or pain response to cold temperature has been related to radicular findings in the spine as discriminated from axial pain ([Scholz et al., 2009](#)). To confirm a reported hypoalgesic area, some examiners may choose to complete multiple tests that may be done with the patient's eyes closed: 1) having the patient say yes or no whenever the patient thinks a stimulus has been applied; 2) repeatedly redefining the affected area ([Goetz, 2007](#); [Lanska, 2006](#)).

Refer to the following Physical Examination Findings Reference Tables for details.

e. **Physical Examination Findings Reference Table: Specific Musculoskeletal Diagnoses**

<b>DIAGNOSIS</b>	<b>SYMPTOMS</b>	<b>SIGNS (Required Findings)</b>
Aggravated Osteoarthritis of the Wrist	Pain usually in the carpometacarpal joints; or in metacarpophalangeal joints.	<p><u>At least one of the following:</u></p> <ul style="list-style-type: none"> <li>• Positive grind test resulting in pain; crepitus;</li> <li>• Subluxation of the metacarpal may be induced in advanced cases;</li> <li>• Swelling;</li> <li>• Reduced motion;</li> <li>• Angular deformities;</li> <li>• Tenderness with palpation of thumb metacarpophalangeal or carpometacarpal joint.</li> </ul>
de Quervain's Disease	Tenderness over the first dorsal extensor compartment (anatomical snuff box).	<p><u>At least one of the following:</u></p> <ul style="list-style-type: none"> <li>• Pain worsened by resisted thumb abduction and/or extension with or without resistance;</li> <li>• Positive Finkelstein's test.</li> </ul>
Epicondylitis-Lateral (Epicondylalgia)	Elbow pain over the lateral epicondyle increased with gripping.	<p>Tenderness to palpation at/near lateral epicondyle and pain over the lateral epicondyle and/or extensor mass of the forearm with one of the following maneuvers:</p> <ul style="list-style-type: none"> <li>• Active or resisted wrist extension;</li> <li>• Active or resisted middle finger extension;</li> <li>• Active or resisted supination.</li> </ul>

<b>DIAGNOSIS</b>	<b>SYMPTOMS</b>	<b>SIGNS (Required Findings)</b>
Epicondylitis-Medial (Epicondylalgia)	Elbow pain over the medial epicondyle.	<p>Tenderness to palpation at/near medial epicondyle and pain over the medial epicondyle and/or flexor mass of the forearm with one of the following maneuvers:</p> <ul style="list-style-type: none"> <li>• Active or resisted wrist flexion;</li> <li>• Active or resisted pronation.</li> </ul>
Extensor Tendon Disorders of the Wrist	Pain localized to the affected tendon(s) worsened by wrist or finger extension.	Pain and/or tenderness with active or resisted wrist/digit extension, specific to the extensor mechanism involved.
Flexor Tendon Disorders of the Wrist	Pain/tenderness localized to affected tendons.	Reproduction of pain with active or resisted wrist/digit flexion or ulnar deviation specific to the flexor mechanism involved.
Triangular Fibrocartilage Complex Tear (TFCC)	Symptoms mainly on ulnar side of the wrist.	<p>Tenderness over the TFCC complex and localized pain, clicking, or findings of abnormal motion with one of the following movements:</p> <ul style="list-style-type: none"> <li>• Forced supination and pronation with axial pressure on an ulnar deviated wrist;</li> <li>• The patient pushes up from a seating position using the hand, and/or</li> <li>• Ballotment of the distal ulna with the wrist supinated causes abnormal motion as compared to the asymptomatic side.</li> </ul>
Trigger Finger	Difficulty flexing the finger with a catching or triggering sensation.	<p><u>One of the following:</u></p> <ul style="list-style-type: none"> <li>• Tenderness at the A-1 pulley with finger flexion;</li> </ul>

DIAGNOSIS	SYMPTOMS	SIGNS (Required Findings)
Trigger Finger, continued		<ul style="list-style-type: none"> <li>• Triggering of the digit;</li> <li>• Difficulty flexing and extending the finger with a palpable nodule.</li> </ul>

f. **Physical Examination Findings Reference Table: Specific Peripheral Nerve Diagnoses**

DIAGNOSIS	SYMPTOMS	SIGNS (Required Findings)
Carpal Tunnel Syndrome	<p>Specific paresthesias in 2 of the following digits: thumb, index, and middle finger.</p> <p>Shaking of the hand (to relieve symptoms) and nocturnal symptoms are common.</p>	<p><u>At least one of the following:</u></p> <ul style="list-style-type: none"> <li>• Positive Phalen's sign;</li> <li>• Positive Tinel's sign over the carpal tunnel;</li> <li>• Positive closed fist test;</li> <li>• Positive compression test;</li> <li>• Thenar atrophy may be present later in course;</li> <li>• Weakness of abductor pollicis brevis;</li> <li>• Sensory loss to pinprick, light touch, two-point discrimination or Semmes-Weinstein monofilament tests in a median nerve distribution. No loss of sensation in the central palm.</li> </ul>

DIAGNOSIS	SYMPTOMS	SIGNS (Required Findings)
Cubital Tunnel Syndrome	Paresthesias or dull, aching sensations in the 4th and 5th digits (ring and small fingers) and discomfort near the medial aspect of the elbow.	Paresthesias or dull, aching in the 4th and 5th digits and at least one of the following exam findings: <ul style="list-style-type: none"> <li>● Diminished sensation of the fifth and ulnar half of the ring fingers, which may sometimes include sensory loss to pinprick, light touch, two-point discrimination or Semmes-Weinstein monofilament tests in an ulnar nerve distribution;</li> <li>● Positive elbow flexion/ulnar compression test;</li> <li>● Later stages manifested by: intrinsic atrophy and ulnar innervated intrinsic weakness; Wartenberg's sign; Froment's sign.</li> </ul>
Guyon Canal (Tunnel) Syndrome	Paresthesias in the 4th and 5th digits (ring and small fingers) without proximal ulnar complaints.	<u>At least one of the following exam findings:</u> <ul style="list-style-type: none"> <li>● Positive Tinel's at hook of hamate;</li> <li>● Numbness or paresthesias of the palm surface of the ring and small fingers;</li> <li>● Decreased strength of the adductor pollicis, abductor digiti minimi, and/or lumbricals.</li> </ul>
Posterior Interosseous Nerve Entrapment (PIN)	Weakness of finger and thumb extension	Weakness or inability to extend fingers, thumb or wrist in neutral or ulnar deviation;
Pronator Syndrome	Pain/paresthesias in the median nerve distribution distal to the elbow.	Paresthesias in the median nerve distribution and at least one of the following reproduces median nerve symptoms:

DIAGNOSIS	SYMPTOMS	SIGNS (Required Findings)
Pronator Syndrome, continued		<ul style="list-style-type: none"> <li>● Resisted pronation with elbow flexed at 90 degrees or elbow extended;</li> <li>● Positive Tinel's at the proximal edge of the pronator teres muscle over the median nerve.</li> </ul>
Radial Tunnel Syndrome	<p>Pain over the lateral posterior forearm. May occur in conjunction with and must be distinguished from lateral epicondylitis.</p> <p>May include paresthesias over the dorsal radial hand and wrist.</p>	<p><u>The following two elements are required:</u></p> <ul style="list-style-type: none"> <li>● Tenderness over the radial nerve near the proximal edge of the supinator muscle;</li> <li>● Resisted supination or resisted middle finger extension with the forearm pronated and extended reproduces symptoms.</li> </ul>

REFERENCED



## 2. LABORATORY TESTING

Laboratory tests are generally accepted, well-established and widely used procedures. Patients should be carefully screened at the initial exam for signs or symptoms of diabetes, hypothyroidism, arthritis, and related inflammatory diseases. The presence of concurrent disease does not refute work-relatedness of any specific case. This frequently requires laboratory testing. In one study of patients with cumulative trauma conditions (other than carpal tunnel syndrome) who have been seen by specialists, 3% were diagnosed with diabetes, 6% with hypothyroidism, and 9% with a chronic inflammatory disease including spondyloarthropathy, arthritis, and systemic lupus erythematosus. Up to two thirds of the patients were not aware of their concurrent disease ([Atcheson et al., 1998](#)). When a patient's history and physical examination suggest infection, metabolic or endocrinologic disorders, tumorous conditions, systemic musculoskeletal disorders (e.g., rheumatoid arthritis or ankylosing spondylitis), or problems potentially related to medication (e.g., renal disease and non-steroidal anti-inflammatory medications), then laboratory tests, including, but not limited to the following can provide useful diagnostic information:

- a. Thyroid stimulating hormone (TSH) for hypothyroidism;
- b. Diabetic screening: recommended for men and women with a BMI over 30, patients with a family history of diabetes, those from high risk ethnic groups, and patients with a previous history of impaired glucose tolerance. There is some evidence that patients with upper extremity disorders are less likely to control their diabetes. Therefore, it is appropriate to order a hemoglobin A1c to screen any diabetic patients with a cumulative trauma conditions or for initial screening ([Ramchurn et al., 2009](#));
- c. Serum protein electrophoresis;
- d. Sedimentation rate and C-reactive protein (CRP) are nonspecific but elevated in infection, neoplastic conditions and rheumatoid arthritis. Other screening tests to rule out inflammatory or autoimmune disease may be added when appropriate;
- e. Serum calcium, phosphorus, uric acid, alkaline and acid phosphatase for metabolic, endocrine and neo-plastic conditions;
- f. Complete blood count (CBC), liver and kidney function profiles for metabolic or endocrine disorders, or for adverse effects of various medications;
- g. Bacteriological (microorganism) work-up for wound, blood, and tissue;
- h. Serum B6: Routine screening is **not recommended** due to the fact that Vitamin B6 supplementation has not been proven to affect the course of carpal tunnel syndrome. However, it may be appropriate for patients on medications that

interfere with the effects of Vitamin B6 or for those with significant nutritional problems.

The Division recommends that the workers' compensation carrier cover initial lab diagnostic procedures to ensure that an accurate diagnosis and treatment plan is established. When the authorized treating provider has justification for the test, insurers should cover the costs. Laboratory testing may be required periodically to monitor patients on chronic medications.

### **3. MEDICAL CAUSATION ASSESSMENT FOR CUMULATIVE TRAUMA CONDITIONS**

#### **General Principles of Medical Causation Assessment**

The clinician must determine if it is medically probable (greater than 50% likely or more likely than not) that the need for treatment in a case is due to a work-related exposure or injury. Treatment for a work-related condition is covered when: 1) the work exposure causes a new condition; or 2) the work exposure activates or exacerbates a previously asymptomatic latent medical condition; or 3) the work exposure combines with, accelerates, or aggravates a pre-existing symptomatic condition; or 4) the work exposure combines with a pre-existing co-morbid condition, such as diabetes, to render the occurrence of a cumulative trauma condition more probable in combination with the work related exposure. The provider should consider: "Is it medically probable that the patient would need the recommended treatment if the work exposure had not taken place?" If the answer is "yes," then the condition is probably not work-related. In some cases, the clinician may need to order diagnostic testing or job site evaluations to make a judgment on medical probability.

The medical causation assessment for cumulative trauma conditions is not a substitute for a legal determination of causation/compensability by an Administrative Law Judge. Legal causation is based on the totality of medical and non-medical evidence, which may include age, gender, pregnancy, BMI, diabetes, wrist depth/ratio, and other factors based on epidemiologic literature.

The steps in a medical causation assessment for cumulative trauma conditions are:

**Step 1:** Make a specific and supportable diagnosis. Remember that cumulative trauma, repetitive strain and repetitive motion are not diagnoses. Examples of appropriate diagnoses include: specific tendonopathies, strains, sprains, and mono-neuropathies. Refer to Section F Specific Musculoskeletal Disorders and Section G Specific Peripheral Nerve Disorders for the specific findings of common cumulative trauma conditions. Less common cumulative trauma conditions not listed specifically in these Guidelines are still subject to medical causation assessment.

- Step 2:** Determine whether the disorder is known to be or is plausibly associated with work. The identification of work-related risk factors is largely based on comparison of the patient's work tasks with risk factors (as described in Section D.3.a Foundations for Evidence of Occupational Relationships and Section D.3.b Using Risk Factors to Determine Causation).
- Step 3:** Interview the patient to find out whether risk factors are present in sufficient degree and duration to cause or aggravate the condition. Consider any recent change in the frequency or intensity of occupational or non-occupational tasks. In some cases, a formal job site evaluation may be necessary to quantify the actual ergonomic risks. Refer to Section E.6.c Job Site Evaluations.
- Step 4:** Complete the required match between the risk factors identified in Section D.3.d Risk Factors Definitions Table and the established diagnosis using the system described in Section D.3.b. Remember that preexisting conditions may be aggravated by, or contribute to, exposures lower than those listed on the table. Those preexisting conditions must be determined by the authorized treating physician based on physiologic plausibility.
- Step 5:** Determine whether a temporal association exists between the workplace risk factors and the onset or aggravation of symptoms.
- Step 6:** Identify non-occupational diagnoses, such as rheumatoid arthritis, obesity, diabetes, as well as avocational activities, such as golf and tennis. This information can affect the medical causation assessment. It may be applicable when exposure levels are low and the case does not meet evidence-based criteria.

**a. Foundations for Evidence of Occupational Relationships**

All results described in this section are a result of a thorough review of the epidemiologic literature available at the time of these Guidelines. One limitation of an epidemiological literature review is that studies rely most heavily upon healthy worker populations and may not reflect the worker population with other concurrent disease or comorbidities. No single epidemiological study fulfills all the criteria for medical causation. Consequently, individual variability lies outside the scope of epidemiological studies and must be addressed by a physician who takes into account not only force, posture, and repetition but also other premorbid risk factors.

The clinician is responsible for documenting specific information regarding the force, posture, repetition, and other risk factors as listed in Section D.3.d Risk Factors Definitions Table. Job title alone is not sufficient to determine the risk factors. A job site evaluation is usually necessary.

Many studies have been completed in industrial settings and focus on cumulative trauma conditions or upper extremity complaints in relationship to work exposures. The studies vary in several ways that directly affect the interpretation of their results. Studies that provide the strongest evidence have 1) an accepted clinical exam confirming the diagnosis and 2) work exposures validated by direct observation or questionnaires that were correlated with direct observation. Well-done, prospective, longitudinal studies (cohort studies) are preferred. However, for uncommon disorders, these studies may not be able to identify all factors contributing to causation. These Guidelines consider other large prevalence and incidence studies which meet minimum quality criteria and use reliable questionnaires for self-reported exposure.

Many studies report symptoms rather than diseases. These studies are useful for ergonomic research or as pilot studies but do not directly affect the evidence level for causation. They are mentioned, when useful, as indirect evidence. If multiple well-done symptom studies show no increase in symptomatology with specific activities, it follows that there is very little chance that the studied exposure causes disease.

In addition, there are a few studies which address less common musculoskeletal diagnoses or peripheral nerve conditions other than carpal tunnel syndrome, such as posterior interosseous nerve entrapment and pronator syndrome. In these cases, these Guidelines rely upon studies which report the risks for related conditions.

Many of the original studies identifying diagnosable cumulative trauma conditions were performed in manufacturing industries and meat, fish and poultry processing companies. In these industries, most workers are exposed to highly repetitive mono-task jobs which frequently involve a forceful grip, awkward postures, vibration, and cold environments. The evidence for increased disorders when these multiple risk factors are present is compelling ([National Institute of Occupational Safety and Health \[NIOSH\], 1997](#); [Punnett, 1998](#); [Punnett, Gold, Katz, Gore, & Wegman, 2004](#); [Roquelaure et al., 2009](#)). Research attempting to define clear, threshold exposure limits for increased risk from isolated tasks and/or intermittent exposures has less consistent results.

The quality of keyboarding studies is highly variable. Most of the studies rely on self-report. Self-report appears to approximately double the actual time spent using the keyboard. Some studies show distortion highest in the medium range of use ([Homan & Armstrong, 2003](#); [Mikkelsen et al., 2007](#)). There appears to be less inflation for self-reported mouse use ([Mikkelsen et al., 2007](#); [Pope, Silman, Cherry, Pritchard, & Macfarlane, 1998](#)). Fortunately, a few studies have provided more objective keyboard use data.

The group of studies now available provides good evidence that keyboarding in a reasonable ergonomic posture (wrist with 30 degrees or less of extension and 15 degrees or less of radial deviation) up to 7 hours per day under usual conditions is very unlikely to cause carpal tunnel syndrome or other upper extremity disorders. This conclusion is based on studies of carpal tunnel pressure under a variety of typing and wrist positions as well as a number of studies of workers who keyboard on a regular basis ([Andersen et al., 2003](#); [Atroshi, Gummesson, Ornstein, Johnsson, & Ranstam, 2007](#); [Jensen, 2003](#); [Lassen et al., 2004](#); [Mediouni et al., 2014](#); [Palmer, Harris, & Coggon, 2007](#); [Roquelaure et al., 2009](#); [Shiri, Viikari-Juntura, Varonen, & Heliovaara, 2006](#); [Thomsen, Gerr, & Atroshi, 2008](#)). Clinicians may determine in a particular case that there is a relationship based on the ergonomic conditions or on excessive typing, such as more than 7 hours per day of essentially uninterrupted keyboard use or full-day court reporting ([Ali & Sathiyasekaran, 2006](#)).

There is some evidence that mouse use appears to be associated with carpal tunnel syndrome and related symptoms with 4 hours or greater of continuous use per day ([Andersen et al., 2003](#); [Stevens, Witt, Smith, & Weaver, 2001](#)). Studies of pressure within the carpal tunnel indicated that pressures may rise to levels which could affect the median nerve when the mouse is being dragged or clicked ([Keir, Bach, & Rempel, 1999](#)). Again, the actual ergonomics of the work place should be considered for each individual patient before making a final causation decision.

There is a large variety in assessment strategies for lower quality studies. Examples include: 1) symptom only reports; 2) dichotomous choices for exposures, e.g., 1 hour or less per week of repetitive activities versus more than 1 hour per week; 3) self-reported data that does not follow basic pathophysiology, e.g., mouse use between 2.5 and 5 hours per week causing wrist pain; and 4) bias introduced due to prior knowledge of the participants regarding expected work and symptom correlations. In order to reasonably integrate the volume of disparate data, interpretation of lower quality studies took into account reasonable pathophysiology and exposure limits. Dose response relationships were also examined to look for trends in exposure which resulted in increased disease or symptoms.

Most studies were unable to truly assess repetition alone. Indirect evidence from a number of studies supports the conclusion that task repetition up to 6 hours per day unaccompanied by other risk factors is not causally associated with cumulative trauma conditions ([Descatha, Leclerc, Chastang, Roquelaure, & Study Group on Repetitive, 2003](#); [Feveile, Jensen, & Burr, 2002](#); [Haahr & Andersen, 2003](#); [Leclerc et al., 2001](#); [Roquelaure et al., 2002](#)). Risk factors likely to be associated with specific CTC diagnostic categories include: extreme wrist or elbow postures; force including regular work with hand tools greater than 1 kg or tasks requiring greater than 50% of an individual's voluntary maximal strength;

work with vibratory tools at least 2 hours per day; or cold environments ([Haahr & Andersen, 2003](#); [Punnett, 1998](#); [Shiri, Miranda, Heliovaara, & Viikari-Juntura, 2009](#); [Shiri et al., 2006](#)).

The variability in study design presented a challenge for creating physiologically reasonable hour limits for the specific primary and secondary risk factors. These Guidelines define risk factor cutoff measures by selecting the strongest studies for specific risks and extrapolating measures. For example,  $\frac{3}{4}$  of a day exposure was translated to a 6 hour exposure. Exposure measures and groups extrapolated in this manner constitute the primary risk factor definitions used in these Guidelines.

Regarding secondary risk factors, the previous version of these Guidelines used a 4 hour exposure cutoff for determining physiologically acceptable limits based on: 1) one study which provides some direct evidence of 4 hours for the most common risks ([Haahr & Andersen, 2003](#)) and 2) indirect evidence from other studies, such as one assessing upper extremity functional impairment and another determining the presence of upper extremity symptoms ([Gardner, Dale, VanDillen, Franzblau, & Evanoff, 2008](#); [Macfarlane, Hunt, & Silman, 2000](#)). Two new studies now suggest that 3 hours is a preferable cutoff for determining physiologically acceptable secondary risks ([Fan et al., 2014](#); [Harris-Adamson et al., 2015](#)).

No studies examined the relationship between the development of ganglion cysts and work activities. However, work activities, such as bending or twisting of the wrist repetitively, may cause an aggravation of existing ganglion cysts that interferes with function ([Tanaka, Petersen, & Cameron, 2001](#)).

Aggravation of a pre-existing medically established diagnosis must be determined on an individual case basis. A comparison of the worker's specific job duties with usual activities of daily living and the occupational risk factors should contribute to the discussion.

#### Non-occupational exposures

Most studies demonstrate an association of cumulative trauma conditions with older age; high BMI; the presence of other upper extremity musculoskeletal diagnoses; related diseases such as auto-immune conditions, diabetes, hypothyroidism and rheumatologic diseases; and psychosocial issues including relationships with supervisors. The influence of these non-occupational risk factors varies according to the specific diagnoses involved. These additional factors may contribute to the disorder and may impact legal causation, but they do not negate the actual evidence from the defined risk factors supporting a specific work related condition ([Descatha et al., 2003](#); [Descatha, Leclerc, Chastang, Roquelaure, & Study Group on Repetitive, 2004](#); [Gell, Werner,](#)

[Franzblau, Ulin, & Armstrong, 2005](#); [Roquelaure et al., 2006](#); [Roquelaure et al., 2009](#); [Roquelaure, Mariel, Dano, Fanello, & Penneau-Fontbonne, 2001](#); [Werner, Franzblau, Gell, Ulin, & Armstrong, 2005a, 2005b](#)).

Use Section D.3.d Risk Factors Definitions Table and Section D.3.e Diagnosis-Based Risk Factors Table with the following directions to formulate the causation of diagnoses established as cumulative trauma conditions.

**b. Using Risk Factors for Medical Causation Assessment of Cumulative Trauma Conditions**

The physician should perform the following:

**Step 1. Determine the diagnosis.**

Using the history, physical examination and supporting studies, a medical diagnosis must be established. Refer to Section F Specific Musculoskeletal Diagnosis and Section G Specific Peripheral Nerve Diagnosis. Less common cumulative trauma conditions not listed specifically in these Guidelines are still subject to medical causation assessment.

**Step 2. Clearly define the job duties of the worker.**

Do not rely solely on the employer's description of job duties. The worker's description of how they actually perform the duties is extremely important. Job site evaluations are always appropriate, but they are sometimes unnecessary when the physician can identify the job duty that appears to be causing the symptoms and provide a method for ergonomically correcting the activity. Job site evaluations performed to identify risk factors should always include appropriate ergonomic alterations. It may not be possible to recommend ergonomic alterations in industrial settings where the employer is incapable of making changes or ergonomic changes are not feasible.

**Step 3. Compare the worker's duties with the Primary Risk Factor Definition Table.**

Hours are calculated by adding the total number of hours per day during which the worker is exposed to the defined risk. Breaks, time performing other activities, and inactive time are not included in the total time. When the employee meets the definition for a sole Primary Risk Factor and the risk factor is physiologically related to the diagnosis, it is likely that the worker will meet causation for the cumulative trauma condition. When the Primary Risk Factor identified is not physiologically related to the

diagnosis, causation will not be established at this point. The provider then needs to consider Step 4.

**Step 4. Compare the worker's risk factors identified in Step 2 with the Secondary Risk Factor definitions on the Risk Factor Definition Table. If secondary risk factors are identified, proceed to the Diagnosis Based Risk Factor Table.**

When no Primary Risk Factors are present but one or more Secondary Risk Factors are found on the Risk Factor Definitions Table, proceed to the Diagnosis Based Risk Factor Table. Elements in this table are listed under the strength of evidence headings. This includes a category for strength of evidence for risks that have been demonstrated not to be related to the diagnosis. Consult the diagnostic category pertaining to the worker. For a number of less common diagnoses, little direct research has been done that meets the quality standards. Therefore, the risk factors for these diagnoses use the risk factors from physiologically related, better researched diagnostic titles. Initially, check the evidence statements for or against causation based on the secondary risks identified previously. If the Diagnosis Based Risk Factor table establishes a match between the Secondary Risk Factor(s) and other job duties using the evidence based columns for the established diagnosis, the case is likely work-related. If none of the evidence categories match the worker, causation based solely on epidemiological evidence from research has not been established.

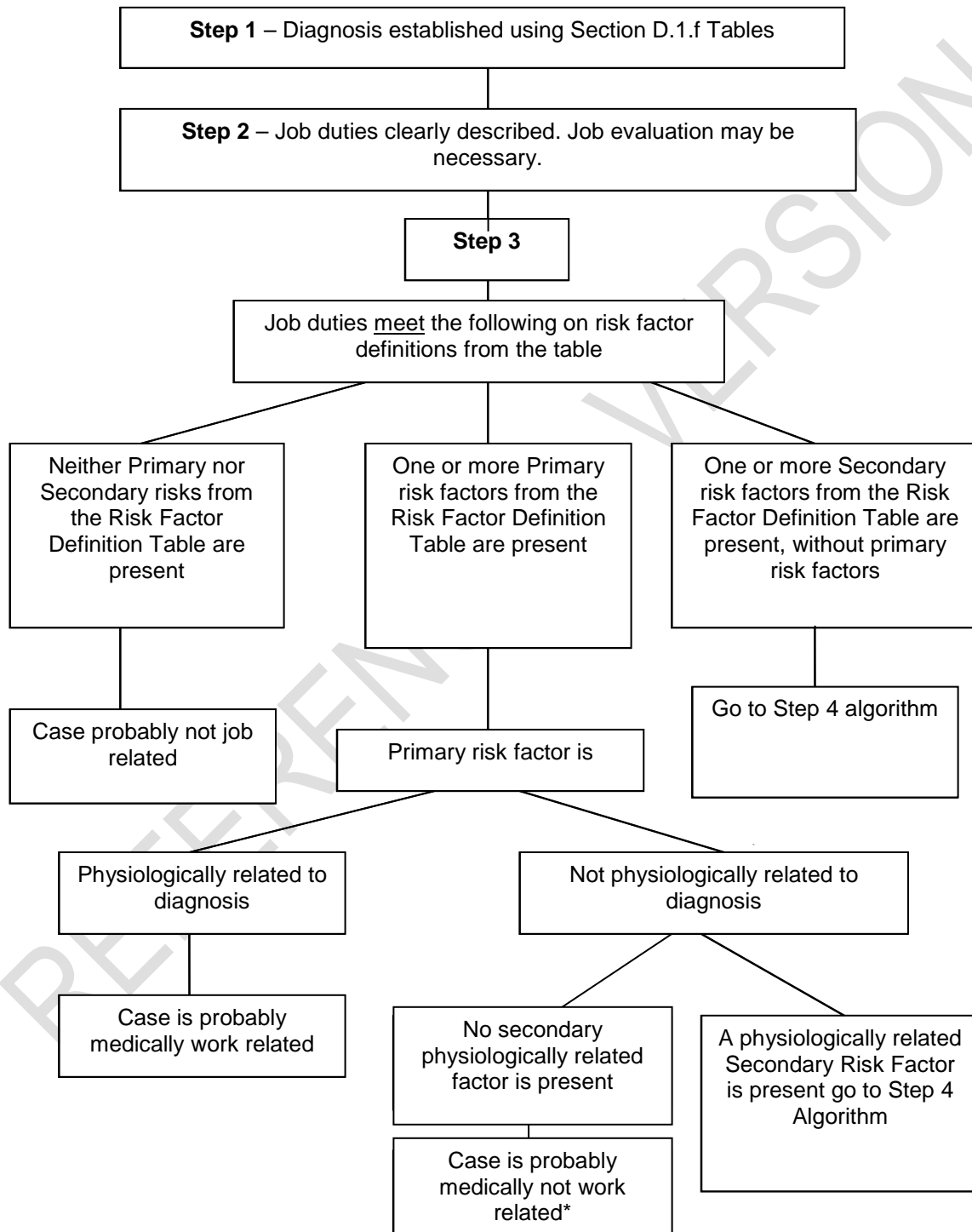
**Step 5.** If an evidence-based medical causation relationship, based on Steps 1-4, has not been established and the worker has one Secondary Risk Factor from Section D.3.d Risk Factors Definitions Table, the physician may consult the last column of Section D.3.e Diagnosis-Based Risk Factors Table entitled "Additional Risk Factors." This category describes medically accepted physiological risk factors for the diagnosis and risk factors which demonstrated an association with the diagnosis in lower quality studies that did not meet the standards of evidence. Some of the additional risk factors have less clear definitions due to lack of definition in the lower quality studies. These risk factors were added only when the medical professionals on the multi-disciplinary task force agreed they were physiologically plausible. When a Secondary Risk Factor has been identified that does not meet the evidence based definitions Section D.3.e Diagnosis-Based Risk Factors Table, physicians may use the other "Additional Risk Factors," as appropriate, to establish the presence of combined risk factors. The worker must have met at least one of the Secondary Risk Factor definitions from the Risk Factors Definition Table and that risk factor must be physiologically related to the diagnosis, in



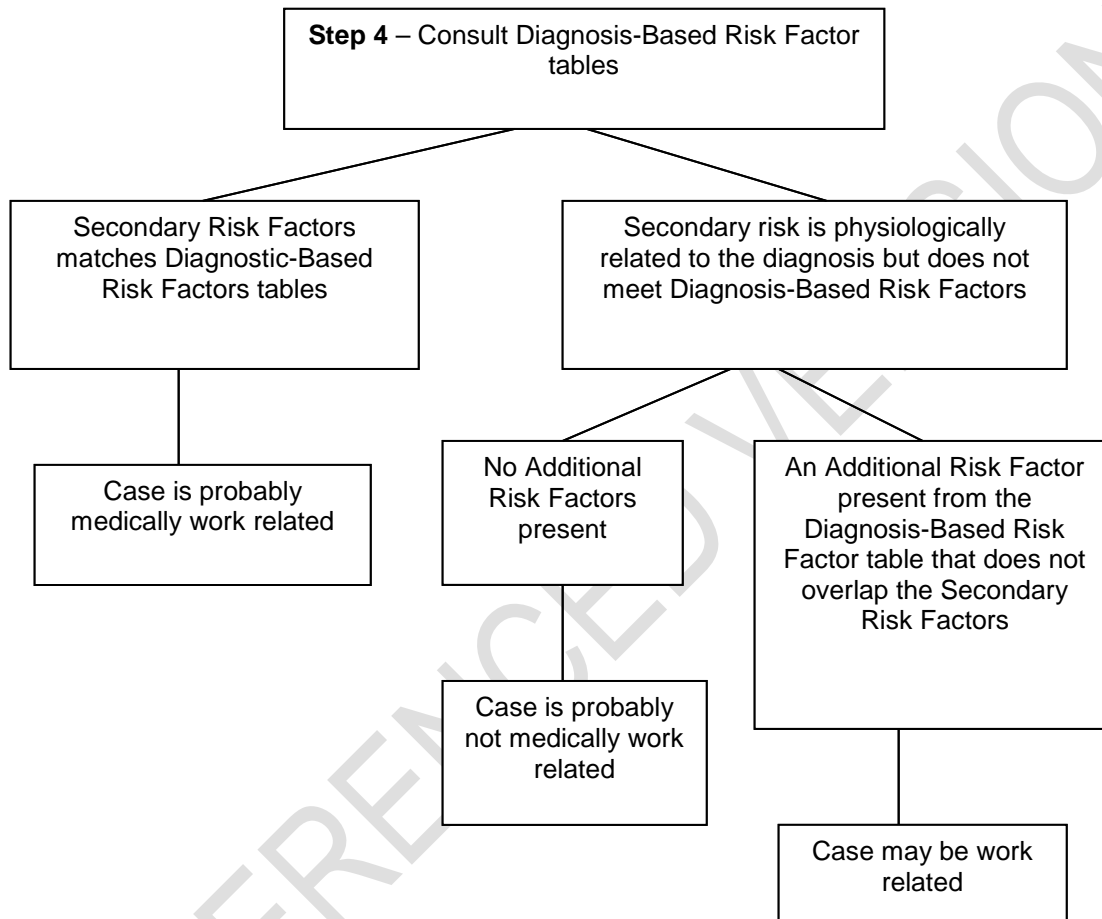
order to use the “Additional Risk Factors” in the Diagnosis Based Risk Factor Table. Additional Risk factors that duplicate the conditions in the Secondary Risk Factor identified for the case may not be used. Any conclusions using this methodology are not strictly evidence-based and therefore the physician should include a discussion of why the Additional Risk Factors are pertinent in the particular case.

REFERENCED VERSION

c. **Algorithmic Steps for Medical Causation Assessment**



#### Algorithmic Steps for Medical Causation Assessment continued



\*In the case of an aggravation or exacerbation of a pre-existing condition, the provider will need to make an individualized causation decision based on the presence of other accompanying conditions.

d. Risk Factors Definitions Table

Category	As a Primary Risk Factor	Citations / Comments	Secondary Risk Factor	Citations / Comments
<b>Force and Repetition/Duration</b>	6 hrs. of: use of 2 pounds pinch force or 10 pounds hand force 3 times or more per minute.	<a href="#">(National Institute of Occupational Safety and Health [NIOSH], 1997)</a> <a href="#">(Haahr &amp; Andersen, 2003; Harris-Adamson et al., 2015)</a>	3 hrs. of: use of 2 pounds pinch force or 10 pounds hand force 3 times or more per minute.	<a href="#">(Haahr &amp; Andersen, 2003; Harris-Adamson et al., 2015)</a>
	6 hrs. of: lifting 10 lbs > 60x per hour.	<a href="#">(Fan et al., 2009)</a>	3 hrs. of: lifting 10 lbs > 60x per hour.	Indirect evidence
	6 hrs. of: use of hand held tools weighing 2 lbs are greater.	<a href="#">(Haahr &amp; Andersen, 2003; Roquelaure et al., 1997)</a>	3 hrs. of: use of hand held tools weighing 2 lbs or greater.	<a href="#">(Haahr &amp; Andersen, 2003)</a>
<b>Awkward Posture and Repetition/Duration</b>	4 hrs. of: Wrist flexion > 45 degrees, extension > 30 degrees, or ulnar deviation > 20 degrees.	<a href="#">(Descatha, Dale, Jaegers, Herquelot, &amp; Evanoff, 2013; Haahr &amp; Andersen, 2003; National Institute of Occupational Safety and Health [NIOSH], 1997; Nordstrom, Vierkant, DeStefano, &amp; Layde, 1997)</a>		

Category	As a Primary Risk Factor	Citations / Comments	Secondary Risk Factor	Citations / Comments
<b>Awkward Posture and Repetition/Duration, continued</b>	6 hrs. of: Elbow - flexion > 90 degrees.	<a href="#">(Haahr &amp; Andersen, 2003)</a>	3 hrs. of: Elbow - flexion > 90 degrees.	<a href="#">(Haahr &amp; Andersen, 2003)</a>
	4 hrs. of: Supination/pronation with task cycles 30 seconds or less or posture is used for at least 50% of a task cycle.	<a href="#">(Descatha et al., 2004; Leclerc et al., 2001)</a>	3 hrs. of: Supination/pronation of 45° with power grip or lifting.	<a href="#">(Fan et al., 2014)</a>
<b>Computer Work</b>	Note: Up to 7 hours per day at an ergonomically correct workstation is not a risk factor.  Refer to Section H. 6.e Ergonomic Considerations Table for definition of ergonomic risk factors.  > 4 hrs. of: Mouse use.	<a href="#">(Ali &amp; Sathiyasekaran, 2006; Andersen et al., 2003; Atroshi et al., 2007; Mediouni et al., 2014; Roquelaure et al., 2009; Shiri et al., 2006)</a>		
<b>Use of handheld vibratory power tools and Duration</b>	6 hrs. for more common types of vibration exposure.	<a href="#">(Nordstrom et al., 1997)</a>	2 hrs. when accompanied by other risks.	<a href="#">(Roquelaure et al., 2009; Shiri et al., 2009)</a>
Category	As a Primary Risk Factor	Citations / Comments	Secondary Risk Factor	Citations / Comments

<b>Cold Working Environment</b>			Ambient temperature of 45F or less for 4 hrs. or more, such as handling frozen foods that are 10 degrees. This risk factor does not stand alone. It is used in combination with other secondary risk factors. Refer to the following Diagnostic-Based Risk Factors Table.	<a href="#">(Chiang, Chen, Yu, &amp; Ko, 1990)</a>
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REFERENCED VERSION

e. **Diagnosis-Based Risk Factors Table**

**DIAGNOSIS-BASED RISK FACTORS**

Hours are calculated by totaling the cumulative exposure time to the risk over an 8 hour day. Breaks or periods of inactivity or performing other types of work tasks are not included. Unless the hours are specifically stated below, "combination" of factors described below uses the Secondary Risk Factor Definitions from the Risk Factor Definition Table.

Diagnosis	Evidence FOR Specific Risk Factors			Evidence AGAINST Specific Risk Factors	Non-Evidence-Based Additional Risk Factors to Consider. These factors must be present for at least 4 hours of the work day, and may not overlap evidence risk factors. <sup>1</sup>
	<b>Strong</b> Multiple high quality studies	<b>Good</b> One high quality study or multiple adequate studies	<b>Some</b> One adequate study		
<b>Aggravated Osteoarthritis of the Thumb, Carpometacarpal (CMC) and Wrist</b>	No Quality Evidence Available				<p>Work studies support repetitive thumb movement 20 times per minute in women contributing to CMC arthritis (<a href="#">Fontana, Neel, Claise, Ughetto, &amp; Catilina, 2007</a>).</p> <p>Awkward Posture (depending on the joint involved).</p> <p>Repetition of activities affecting the joint involved for 4 hrs (<a href="#">Walker-Bone, Reading, Coggon, Cooper, &amp; Palmer, 2006</a>).</p> <p>Prior Injury.</p>

Diagnosis	Evidence FOR Specific Risk Factors			Evidence AGAINST Specific Risk Factors	<b><u>Non-Evidence-Based Additional Risk Factors to Consider.</u></b> These factors must be present for at least 4 hours of the work day, and may not overlap evidence risk factors. <sup>1</sup>
	<b><u>Strong</u></b> Multiple high quality studies	<b><u>Good</u></b> One high quality study or multiple adequate studies	<b><u>Some</u></b> One adequate study		
<b>Carpal Tunnel Syndrome</b>		<p>Combination of force, repetition, and vibration (<a href="#">National Institute of Occupational Safety and Health [NIOSH], 1997</a>; <a href="#">Shiri et al., 2009</a>).<sup>2,4</sup></p> <p>Combination of repetition and force for 6 hours (<a href="#">Silverstein, Fine, &amp; Armstrong, 1987</a>).</p> <p>Combination repetition and forceful tool use with awkward posture for 6 hours (<a href="#">Frost, Andersen, &amp; Nielsen, 1998</a>).</p> <p>Combination force, repetition, and awkward posture (<a href="#">Mattioli et al., 2009</a>).</p> <p>Combination of 2 pound pinch or 10 pound hand force 3 times or more per minute for 3 hours (<a href="#">Harris-Adamson et al., 2015</a>).</p>	<p>Wrist bending or awkward posture for 4 hrs (<a href="#">Nordstrom et al., 1997</a>).</p> <p>Mouse use more than 4 hours (<a href="#">Andersen et al., 2003</a>).</p> <p>Combination cold and forceful repetition for 6 hours - Frozen food handling (<a href="#">Chiang et al., 1990</a>).</p>	<p>Good evidence - Keyboarding less than or equal to 7 hrs. in good ergonomic position IS NOT RELATED (<a href="#">Ali &amp; Sathiyasekaran, 2006</a>; <a href="#">Andersen et al., 2003</a>; <a href="#">Atroshi et al., 2007</a>; <a href="#">Mediouni et al., 2014</a>; <a href="#">Roquelaure et al., 2009</a>).</p> <p>Good evidence- Repetition alone less than or equal to 6 hrs. IS NOT RELATED (<a href="#">Leclerc et al., 2001</a>; <a href="#">Shiri et al., 2009</a>).</p>	<p>High repetition defined as task cycle times of less than 30 seconds or performing the same task for more than 50% of the total cycle time (<a href="#">Silverstein et al., 1987</a>).<sup>5</sup></p> <p>Tasks using a hand grip.</p> <p>Extreme wrist radial/ulnar positions or elbows in awkward postures (<a href="#">Werner, Franzblau, Gell, Hartigan, et al., 2005</a>).</p>



Diagnosis	Evidence FOR Specific Risk Factors			Evidence AGAINST Specific Risk Factors	<b><u>Non-Evidence-Based Additional Risk Factors to Consider.</u></b> These factors must be present for at least 4 hours of the work day, and may not overlap evidence risk factors. <sup>1</sup>
	<b><u>Strong</u></b> Multiple high quality studies	<b><u>Good</u></b> One high quality study or multiple adequate studies	<b><u>Some</u></b> One adequate study		
<b>Cubital Tunnel Syndrome</b>			Combination forceful tool use, repetition and probably posture for 6 hrs- Holding a tool in position with repetition ( <a href="#">Descatha et al., 2004</a> ).		Wrist bending and/or full elbow flexion/extension, repetition for 4 hours, vibration ( <a href="#">Roquelaure et al., 2009</a> ). <sup>3</sup> Repetitive pronation of forearm. <sup>3</sup> Sustained pressure at the cubital tunnel.
<b>DeQuervain's Disease</b>		Combination force, repetition, & posture ( <a href="#">National Institute of Occupational Safety and Health [NIOSH], 1997</a> ). <sup>2,4</sup>			Wrist in ulnar deviation. <sup>3</sup> Repetitive thumb abduction and extension. <sup>3</sup> Wrist bending in extreme postures. ( <a href="#">Roquelaure et al., 2009</a> ). <sup>3</sup> Precise hand motions e.g., dental hygienists ( <a href="#">Werner, Hamann, Franzblau, &amp; Rodgers, 2002</a> ). Repetitive hitting ( <a href="#">Leclerc et al., 2001</a> ).

Diagnosis	Evidence FOR Specific Risk Factors			Evidence AGAINST Specific Risk Factors	<b>Non-Evidence-Based Additional Risk Factors to Consider.</b> These factors must be present for at least 4 hours of the work day, and may not overlap evidence risk factors. <sup>1</sup>
	<b>Strong</b> Multiple high quality studies	<b>Good</b> One high quality study or multiple adequate studies	<b>Some</b> One adequate study		
<b>Epicondylitis Lateral</b>		<p>Combination – awkward posture (forearm supination past 45 degrees) and forceful lifting (<a href="#">Fan et al., 2009</a>).<sup>2</sup></p> <p>Combination force and possible awkward posture – study used repetition and turning and screwing (<a href="#">Leclerc et al., 2001</a>).</p> <p>Combination forearm pronation 45° or greater with power grip or lifting for 3 hours per day (<a href="#">Fan et al., 2014</a>).</p>	<p>Combination of wrist bending for 4 hours and rotation the forearm for 2 hours (<a href="#">Descatha et al., 2013</a>).</p> <p>Combination repetition and awkward posture including static posture (<a href="#">Ono et al., 1998</a>).</p>	Some evidence keyboard use IS NOT RELATED ( <a href="#">Shiri et al., 2006</a> ).	Wrist posture in extension and repetitive supination of the forearm and/or elbow extension. <sup>3</sup>
<b>Epicondylitis Medial</b>		Combination – force & repetition ( <a href="#">National Institute of Occupational Safety and Health [NIOSH], 1997</a> ) <sup>4</sup> , force and wrist and hand repetition ( <a href="#">Shiri et al., 2006</a> ).	Combination of wrist bending for 4 hours and rotation the forearm for 2 hours ( <a href="#">Descatha et al., 2013</a> ).	Some evidence keyboard use IS NOT RELATED ( <a href="#">Shiri et al., 2006</a> ).	Wrist posture in flex and repetitive pronation and/or elbow extension. <sup>3</sup>

Diagnosis	Evidence FOR Specific Risk Factors			Evidence AGAINST Specific Risk Factors	<b>Non-Evidence-Based Additional Risk Factors to Consider.</b> These factors must be present for at least 4 hours of the work day, and may not overlap evidence risk factors. <sup>1</sup>
	<b>Strong</b> Multiple high quality studies	<b>Good</b> One high quality study or multiple adequate studies	<b>Some</b> One adequate study		
<b>Extensor tendon disorders of the Wrist</b>		<p>Combination - force &amp; repetition (<a href="#">National Institute of Occupational Safety and Health [NIOSH], 1997</a>),<sup>4</sup> force and wrist and hand repetition (<a href="#">Shiri et al., 2006</a>).<sup>2</sup></p> <p>Combination - forceful exertion and repetition 6 hours (<a href="#">Descatha et al., 2003</a>).</p> <p>Combination force, repetition, &amp; posture (<a href="#">National Institute of Occupational Safety and Health [NIOSH], 1997</a>).<sup>2, 4</sup></p>			<p>Sustained tool use.</p> <p>Awkward posture.<sup>3</sup></p> <p>No relationship to keyboard use is expected in a good ergonomic workstation.</p> <p>Wrist bending in extreme postures (<a href="#">Roquelaure et al., 2009</a>).<sup>3</sup></p> <p>Repetitive hitting (<a href="#">Leclerc et al., 2001</a>).</p>
<b>Flexor tendon disorders of the Wrist</b>		<p>Combination force, repetition, &amp; posture (<a href="#">National Institute of Occupational Safety and Health [NIOSH], 1997</a>).<sup>2, 4</sup></p>			<p>Sustained tool use.</p> <p>Awkward posture.<sup>3</sup></p> <p>No relationship to keyboard use is expected in a good ergonomic workstation.</p> <p>Wrist bending in extreme postures (<a href="#">Roquelaure et al., 2009</a>).<sup>3</sup></p> <p>Repetitive hitting (<a href="#">Leclerc et al., 2001</a>).</p>

Diagnosis	Evidence FOR Specific Risk Factors			Evidence AGAINST Specific Risk Factors	<b><u>Non-Evidence-Based Additional Risk Factors to Consider.</u></b> These factors must be present for at least 4 hours of the work day, and may not overlap evidence risk factors. <sup>1</sup>
	<b><u>Strong</u></b> Multiple high quality studies	<b><u>Good</u></b> One high quality study or multiple adequate studies	<b><u>Some</u></b> One adequate study		
<b>Guyon Canal</b>	No Quality Evidence Available.				Ulnar wrist posture and flexion. Direct pressure on the wrist.
<b>Posterior Interosseous Nerve Entrapment</b>	Refer to lateral epicondylitis section above for indirect evidence. No specific evidence available.				Ulnar wrist posture and flexion. Direct pressure on the wrist.
<b>Pronator Syndrome</b>	Refer to medial epicondylitis section above for indirect evidence. No specific evidence available.				Ulnar wrist posture and flexion. Direct pressure on the wrist.
<b>Trigger Finger</b>			Hand tool use – 6 hours ( <a href="#">Gorsche et al., 1998</a> ).		Repeated digital flexion.
<b>Radial Tunnel Syndrome</b>			Repetition and force - force of 1 kg with cycle time < 1 minute or awkward posture (static posture) elbow > 90 degrees ( <a href="#">Roquelaure et al., 2000</a> ).		Repetitive Supination. Extension of the elbow from 0 to 45 degrees ( <a href="#">Roquelaure et al., 2000</a> ).

Diagnosis	Evidence FOR Specific Risk Factors			Evidence AGAINST Specific Risk Factors	<b><u>Non-Evidence-Based Additional Risk Factors to Consider.</u></b> These factors must be present for at least 4 hours of the work day, and may not overlap evidence risk factors. <sup>1</sup>
	<b><u>Strong</u></b> Multiple high quality studies	<b><u>Good</u></b> One high quality study or multiple adequate studies	<b><u>Some</u></b> One adequate study		
<b>Triangular Fibrocartilage Compression</b>	No Quality Evidence Available.				Usually from traumatic hyperextension which may become symptomatic over time.  Wrist posture in extension and repetitive supination of the forearm and/or elbow extension.  For occupational, usually unilateral with ulnar wrist pain while supinating and extending the wrist as part of the regular work duty.

1. Physiological risk factors are those generally agreed upon by the medical community to cause the specific condition described. Other risk factors described are those identified in lower quality studies that are possibly related. These are consensus risk factors.
2. Combined factors refer to the Secondary Risk Factor definitions found in the Risk Factor Definition Table.
3. **Caution:** These additional risk categories may not be used when awkward posture, using a similar definition, has been cited as a Secondary Risk Factor.
4. Evidence rated as strong by National Institute for Occupational Safety and Health (NIOSH) 1997 criteria are placed in the “good” category because the NIOSH strong evidence definition matches the Colorado “good” level of evidence requiring multiple adequate studies.
5. Due to small case size and a definition of low force/high repetition jobs that likely included many jobs qualifying for a force risk from the “Risk Definitions” table, this study does not support repetition as a sole risk factor.

4. **STAGING MATRIX TO CALCULATE CUMULATIVE TRAUMA CONDITION IMPAIRMENT**

Cumulative trauma staging is used to rate permanent impairment of specific disorders when no other rating is available in the American Medical Association (AMA) Guides to the Evaluation of Permanent Impairment, 3rd Edition Revised. Specific diagnoses must be provided prior to the assignment of an impairment rating. Remember that the terms “cumulative trauma disorder,” “repetitive motion syndrome,” “repetitive strain injury,” and similar nomenclatures are umbrella terms that are not acceptable diagnoses. Cumulative Trauma Conditions can be staged only after taking a thorough history and performing an appropriate physical examination (see Section D.1 History-Taking and Physical Examination). The factors included in the Cumulative Trauma Condition Staging Matrix are:

A = History and Physical Examination.

B = Response to Modification of Specific Aggravating Factors.

C = Activities of Daily Living.

It is expected that objective signs on physical examination will correlate with subjective symptoms. The signs and symptoms are staged in the Cumulative Trauma Staging Matrix as:

Stage 1 = Minimal.

Stage 2 = Mild.

Stage 3 = Moderate.

Stage 4 = Severe.

Stages 3 and 4 frequently may be associated with other secondary symptoms of chronic pain such as sleep alteration or depression.

When using the Staging Matrix for impairment rating at maximum medical improvement (MMI), assignment of the patient to a stage should be based primarily on limitations in ADLs and history and physical examination findings. The response to modification of specific aggravating activities may be used to aid the rater in choosing a number within the available rating range.

The staging number chosen from the “Impairment Grades at MMI” row is to be used as a multiplier in conjunction with the AMA Guides to the Evaluation of Permanent Impairment, 3rd Edition Revised, Chapter 3 and Table 17 to determine the impairment

rating for each specific diagnosis. The primary presenting joint that corresponds to each specific established diagnosis should be rated. Descriptions of painful conditions without clear physiologic findings may not be rated using this chart. Examples include pain in the elbow or other upper extremity joint and myofascial pain disorder.

The staging matrix is only used to rate a cumulative trauma condition diagnosis when there is no impairment rating under range of motion, specific diagnosis, and/or peripheral nerve injuries in the AMA Guides, 3rd Edition Revised. All impairment ratings from this table are provided in upper extremity terms and must be multiplied by the upper extremity total impairment rating for the appropriate joint found in Table 17 on page 48 of the AMA Guides, 3rd Edition Revised. The upper extremity rating is then converted to whole person. The table is not intended to distinguish between permanent partial disability paid under §§ 8-42-107(2) and -107(8), C.R.S. This information is also available in the Impairment Rating Tips Desk Aid #11.

REFERENCED VETERAN

### Cumulative Trauma Staging Matrix

	Stage 1 (Minimal)	Stage 2 (Mild)	Stage 3 (Moderate)	Stage 4 (Severe)
History and Physical Examination	1 to 2 symptoms with signs identified on history and supported by physical examination with consistency of subjective and objective findings	2 or more symptoms with signs identified and supported by physical examination with consistency of subjective and objective findings	3 or more symptoms with signs identified and supported by the physical examination with consistency of subjective and objective findings	3 or more symptoms with signs identified and supported by physical examination with consistency of subjective and objective findings
	AND	AND	AND	AND
Response to Modification of Specific Aggravating Factors	Symptoms and/or signs improve or resolve with modification of specific aggravating activity	Symptoms and/or signs may improve but will not resolve completely with modification of specific aggravating activity	Symptoms and/or signs do not improve with modification of the specific aggravating activity but may improve with elimination of the specific aggravating activity	Symptoms and/or signs do not improve with modification or elimination of the specific aggravating activity
	AND	AND	AND	AND
Activities of Daily Living (ADLs)	Minimal problems with ADLs	Noticeable aggravation by more difficult ADLs	Significant interference with most ADLs	Severe limitations of ADLs
Impairment Grades at MMI (See Note below to obtain Multiplier)	0-10%	11-20%	21-30%	31-40%



## E. FOLLOW-UP DIAGNOSTIC IMAGING AND TESTING PROCEDURES

One diagnostic imaging procedure may provide the same or distinct information as another procedure. Therefore, the prudent choice of a single diagnostic procedure, a complement of procedures, or a sequence of procedures will optimize diagnostic accuracy, maximize cost effectiveness (by avoiding redundancy), and minimize potential adverse effects to patients.

All diagnostic imaging procedures have a significant percentage of specificity and sensitivity for various diagnoses. None is specifically characteristic of a certain diagnosis. Clinical information obtained by history-taking and physical examination should be the basis for selection and interpretation of imaging procedure results.

Practitioners should be aware of the radiation doses associated with various procedures and provide appropriate warnings to patients. Coloradans have a background exposure to radiation, and unnecessary CT scans or X-rays increase the lifetime risk of cancer death ([Hendrick et al., 2012](#)).

When a diagnostic procedure, in conjunction with clinical information, provides sufficient information to establish an accurate diagnosis, the second diagnostic procedure will become a redundant procedure. At the same time, a subsequent diagnostic procedure can be a complementary diagnostic procedure if the first or preceding procedures, in conjunction with clinical information, cannot provide an accurate diagnosis. Usually, preference of a procedure over others depends upon availability, a patient's tolerance, and/or the treating practitioner's familiarity with the procedure.

### 1. ELECTRODIAGNOSTIC (EDX) STUDIES

This section does not include automated electrodiagnostic testing such as neurometers and portable automated electrodiagnostic devices. These testing devices are not adequate to determine peripheral neuropathies, radiculopathies, or unusual nerve compression syndromes and should not be used. Neurometers and portable electrodiagnostic testing devices may not be used to make a diagnosis and are *not recommended* in treatment settings. Refer also to Section E.5.a.i Electroneurometer and Section E.5.a.ii Portable Automated Electrodiagnostic Devices.

- a. Electrodiagnostic (EDX) studies are well-established and widely accepted for evaluation of patients suspected of having peripheral nerve pathology. They should only be performed by physicians trained in electromyography. Studies may confirm the diagnosis or direct the examiner to alternative disorders. Studies –require clinical correlation due to the occurrence of false positive and false negative results. Symptoms of peripheral nerve pathology may occur with normal EDX studies, especially early in the clinical course.

Because EDX studies may be negative early in the clinical course, they should be delayed until the patient has been symptomatic for 3 to 6 weeks. Refer to Sections F and G on specific diagnoses for details.

When polyneuropathy is suspected, it is prudent to perform electrodiagnostic testing in the lower extremities.

- b. To assure accurate testing, temperature should be maintained at 32 to 34 degrees C, preferably recorded from the hand/digits.
- c. All studies must include normative values for their laboratories.
- d. Patients should follow the electrodiagnostic physician's recommendations prior to their exam. These usually include: 1) Notifying the physician if you are taking blood thinners, if you are taking a medication affecting the nervous system, or if you have a pacemaker, 2) not smoking or using caffeine before the exam, and 3) wearing loose fitting clothing for the exam.

## 2. **IMAGING STUDIES**

### a. **Radiographic Imaging**

Radiographic imaging of the upper extremities is a generally accepted, well-established and widely used diagnostic procedure when specific indications based on history and/or physical examination are present. It should not be routinely performed for cumulative trauma injuries. It may be useful when clinical findings suggest a fracture, arthritis, avascular necrosis or ligament or cartilage injuries involving the carpals or pain persists after initial treatment. The mechanism of injury and specific indications for the radiograph should be listed on the request form to aid the radiologist and x-ray technician. For additional specific clinical indications, see Section F Specific Musculoskeletal Diagnosis, Testing and Treatment and Section G Specific Peripheral Nerve Diagnosis, Testing and Treatment.

### b. **Magnetic Resonance Imaging (MRI)**

MRI may show increased T2-weighted signal intensity of the common extensor tendon in lateral epicondylitis, but this is common in the asymptomatic contralateral elbow and not sufficiently specific to warrant the use of MRI as a diagnostic test for epicondylitis. MRI may be helpful to diagnose triangular fibrocartilage complex tears and other suspected ligament or bone pathology when clinical findings suggest these diagnoses. Its routine use for cumulative trauma conditions is ***not recommended***.

c. **Computed Axial Tomography (CT)**

CT is generally accepted and provides excellent visualization of bone. It is rarely needed for cumulative trauma conditions. When clinical findings suggest possible bone pathology it may be used to further evaluate bony masses and suspected fractures not clearly identified on radiographic window evaluation. Instrument scatter reduction software provides better resolution when metallic artifact is of concern.

d. **Diagnostic Sonography**

Diagnostic Sonography is an accepted diagnostic procedure to rule out mass lesions. It is rarely appropriate for cumulative trauma condition diagnoses. However, it may be used to rule out ganglions, other space occupying lesions, and tendon injuries. It should not be used to diagnosis carpal tunnel syndrome. The performance of sonography is operator dependent, and is best when done by a specialist in musculoskeletal radiology.

3. **JOINT ASPIRATION**

Joint aspiration is a generally accepted, well-established and widely used procedure when specifically indicated and performed by individuals properly trained in these techniques. It is rarely indicated for cumulative trauma conditions but may be needed when history and/or physical examination are of concern for a septic joint, gout, or bursitis as well as for some acute injuries. Persistent or unexplained effusions may be examined for evidence of infection, rheumatologic, or inflammatory processes. The presence of fat globules in the effusion strongly suggests occult fracture.

4. **PERSONALITY/PSYCHOLOGICAL/PSYCHOSOCIAL EVALUATIONS**

These are generally accepted and well-established diagnostic procedures with selective use in the cumulative trauma conditions population but with more widespread use in sub-acute and chronic pain populations. Diagnostic testing procedures may be useful for patients with symptoms of depression, delayed recovery, chronic pain, recurrent painful conditions, disability problems, and for pre-operative evaluation. These procedures also have a possible predictive value for post-operative response. Psychological testing should provide differentiation between pre-existing depression versus injury caused depression, as well as post-traumatic stress disorder. Formal psychological or psychosocial evaluation should be performed on patients not making expected progress within 6 to 12 weeks following injury and whose subjective symptoms do not correlate with objective signs and tests. In addition to the customary initial exam, the evaluation of the injured worker should specifically address the following areas:

- Employment history;
- Interpersonal relationships — both social and work;
- Leisure activities;
- Current perception of the medical system;
- Results of current treatment;
- Perceived locus of control; and
- Childhood history, including abuse and family history of disability.

This information should provide clinicians with a better understanding of the patient, thus allowing for a more effective rehabilitation. The evaluation will determine the need for further psychosocial interventions. In those cases, a Diagnostic Statistical Manual for Mental Disorders (DSM) diagnosis should be determined and documented. An individual with a PhD, PsyD, or Psychiatric MD/DO credentials should perform initial evaluations, which are generally completed within 1 to 2 hours. When issues of chronic pain are identified, the evaluation should be more extensive and follow testing procedures as outlined in the Division's Chronic Pain Disorder Medical Treatment Guidelines.

- ❖ Frequency: 1 time visit for evaluation. If psychometric testing is indicated as a portion of the initial evaluation, time for such testing should not exceed an additional 2 hours of professional time.

## 5. ADJUNCTIVE TESTING

These tests are not used to establish a diagnosis. They may be used to follow the progress of the patient, depending on their diagnosis or to conduct research.

### a. Automated Electrodiagnostic Testing

- i. Electroneurometer: **not recommended** as a diagnostic tool because it requires patient participation, cannot distinguish between proximal and distal lesions, and does not have well validated reference values.
- ii. Portable Automated Electrodiagnostic Devices: measures distal median nerve motor latency and F-wave latency at the wrist and has been tested in research settings. It performed well in this setting following extensive calibration of the device. Motor nerve latency compared favorably with conventional electrodiagnostic testing, but F-wave latency added little to diagnostic accuracy. It remains an

investigational instrument whose performance in a primary care setting is as yet not established, and is **not recommended** as a substitute for conventional electrodiagnostic testing in clinical decision making.

**b. Pinch and Grip Strength Measurements**

Pinch and grip strength measurements are not generally accepted as a diagnostic tool for cumulative trauma conditions. Strength is defined as the muscle force exerted by a muscle or group of muscles to overcome a resistance under a specific set of circumstances. Pain, the perception of pain secondary to abnormal sensory feedback, and/or the presence of abnormal sensory feedback affecting the sensation of the power used in grip/pinch may cause a decrease in the force exerted and thereby not be a true indicator of strength. When a bell-shaped curve is present, these measures provide a method for quantifying strength that can be used to follow a patient's progress and to assess response to therapy. In the absence of a bell-shaped curve, clinical reassessment is indicated. These measurements may also be useful to determine an individual's fitness for duty or as a reassessment after therapy and/or surgery.

**c. Quantitative Sensory Testing (QST)**

QST may be used as an assessment tool to monitor the patient's progress throughout treatment. Results of tests and measurements of sensory integrity are integrated with the history and review of systems findings and the results of other tests and measures. QST tests the entire sensory pathway, limiting its ability to localize a deficit precisely. It depends on the patient's report of perception and may not be objective. Cutaneous conditions may alter sensory thresholds.

QST may be useful for peripheral polyneuropathy but not for isolated nerve injury or compression syndromes. Although it is not useful diagnostically, it may be used post-operatively for surgically treated mononeuropathies.

- i. Threshold tests measure topognosis, the ability to exactly localize a cutaneous sensation, and pallesthesia, the ability to detect mechanical sensation using vibration discrimination testing (quickly adapting fibers); and/or Semmes-Wienstein monofilament testing (slowly adapting fibers);
- ii. Density tests also measure topognosis and pallesthesia using static two-point discrimination (slowly adapting fibers); and/or moving two-point discrimination (quickly adapting fibers).

## 6. **SPECIAL TESTS**

These are generally well-accepted and are performed as part of a skilled assessment of the patient's capacity to return to work, his/her strength capacities, physical work demand classifications, and tolerance. The procedures in this subsection are listed in alphabetical order.

### a. **Computer-enhanced Evaluations**

These may include isotonic, isometric, isokinetic and/or isoinertial measurements of movement; ROM; endurance; or strength. Values obtained can include degrees of motion, torque forces, pressures, or resistance. Indications include determining validity of effort, effectiveness of treatment, and demonstrated motivation. These evaluations should not be used alone to determine return-to-work restrictions.

- ❖ Frequency: One time for evaluation, one for mid-treatment assessment, and one at final evaluation.

### b. **Functional Capacity Evaluation (FCE)**

This is a comprehensive or modified evaluation of the various aspects of function as they relate to the worker's ability to return to work. Areas such as endurance, lifting (dynamic and static), postural tolerance, specific ROM, coordination and strength, worker habits, employability, as well as psychosocial aspects of competitive employment may be evaluated. Reliability of patient reports and overall effort during testing is also reported. Components of this evaluation may include: (a) musculoskeletal screen; (b) cardiovascular profile/aerobic capacity; (c) coordination; (d) lift/carrying analysis; (e) job-specific activity tolerance; (f) maximum voluntary effort; (g) pain assessment/psychological screening; and (h) non-material and material handling activities. Standardized national guidelines (such as National Institute for Occupational Safety and Health (NIOSH)) should be used as the basis for FCE recommendations.

Most studies examining FCEs were performed utilizing cases involving chronic low back pain. There is some evidence that an FCE fails to predict which injured workers with chronic low back pain will have sustained return to work ([Gross & Battie, 2004](#)). Another cohort study concluded that there was a significant relation between FCE information and return to work, but the predictive efficiency was poor ([Streibelt, Blume, Thren, Reneman, & Mueller-Fahrnow, 2009](#)). There is some evidence that time off work and gender are important predictors for return to work, and floor-to-waist lifting may also help predict return to work. However, the strength of that relationship has not been determined ([Matheson, Isernhagen, & Hart, 2002](#)).

A full review of the literature reveals no evidence to support the use of FCEs to prevent future injuries ([Cochrane] [Mahmud et al., 2010](#)). There is some evidence in chronic low back pain patients that (1) FCE task performance is weakly related to time on disability and time for claim closure, and (2) even claimants who fail on numerous physical performance FCE tasks may be able to return to work ([Gross, Battie, & Cassidy, 2004](#)). These same issues may exist for lower extremity injuries.

Full FCEs are rarely necessary. In many cases, a work tolerance screening or return to work performance will identify the ability to perform the necessary job tasks. There is some evidence that a short form FCE reduced to a few tests produces a similar predictive quality compared to the longer 2-day version of the FCE regarding length of disability and recurrence of a claim after return to work ([Gross, Battie, & Asante, 2007](#)).

When an FCE is being used to determine return to a specific job site, the provider is responsible for fully understanding the physical demands and the duties of the job the worker is attempting to perform. A job site evaluation is usually necessary. A job description should be reviewed by the provider and FCE evaluator prior to this evaluation. FCEs cannot be used in isolation to determine work restrictions. It is expected that the FCE may differ from both self-report of abilities and pure clinical exam findings in chronic pain patients ([Brouwer et al., 2005](#)). The length of a return to work evaluation should be based on the judgment of the referring physician and the provider performing the evaluation. Since return to work is a complicated multidimensional issue, multiple factors beyond functional ability and work demands should be considered and measured when attempting determination of readiness or fitness to return to work ([Gross et al., 2007](#)). FCEs should not be used as the sole criteria to diagnose malingering.

- ❖ Frequency: Once, when patient is unable to return to the pre-injury position and further information is desired to determine permanent work restrictions. **Prior authorization is required for repeat Functional Capacity Evaluations.**

**c. Job Site Evaluations and Alterations**

Ergonomic alterations should be done early to assure that appropriate changes are accomplished early in the treatment program. Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite. Job site evaluation and alteration should include input from a healthcare professional with experience in ergonomics or a certified

ergonomist, the employee, and the employer. The employee must be observed performing all pertinent job functions in order for the job site evaluation to be a valid representation of a typical workday. If the employee is unable to perform the job function for observation, a co-worker in an identical job position may be observed instead. The job site evaluation should include a job demand analysis with an ergonomic evaluation, which directly addresses the causation risk factors described in Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions and the five goals listed below.

A formal job site evaluation is a comprehensive analysis of the physical, mental and sensory components of a specific job. It may be important initially to determine causation. These components may include, but are not limited to: (a) postural tolerance (static and dynamic); (b) aerobic requirements; (c) range-of-motion; (d) torque/force; (e) lifting/carrying; (f) cognitive demands; (g) social interactions; (h) visual perceptual; (i) environmental requirements of a job; (j) repetitiveness; and (k) essential functions of a job. Ergonomic changes that provide a therapeutic benefit or relieve the patient's ongoing symptoms are part of the required medical treatment for cumulative trauma conditions. and therefore, it is assumed that the insurer will be responsible for paying for such job site alterations. Job descriptions provided by the employer are helpful but should not be used as a substitute for direct observation. A job site evaluation may include observation and instruction of how work is done, what material changes (desk, chair) should be made, and determination of readiness to return to work. Refer to Section H.6 Job site Alterations for specific ergonomic recommendations. Requests for a job site evaluation should describe the expected goals for the evaluation. Goals may include, but are not limited to the following:

- i. To determine if there are potential contributing factors to the person's condition and/or for the physician to assess causality;
- ii. To make recommendations for, and to assess the potential for ergonomic changes;
- iii. To provide a detailed description of the physical and cognitive job requirements;
- iv. To assist the patient in their return to work by educating him/her on how to do the job more safely in a bio-mechanically appropriate manner; and/or
- v. To give detailed work/activity restrictions.



- ❖ Frequency: 1 time with additional visits as needed for follow-up per job site.

d. **Vocational Assessment**

Once an authorized practitioner has determined that a patient will not be able to return to his/her former employment and can prognosticate final restrictions, a timely vocational assessment can be implemented. The vocational assessment should provide valuable guidance in the determination of future rehabilitation program goals. It should clarify rehabilitation goals, which optimize both patient motivation and utilization of rehabilitation resources. The effectiveness of vocational rehabilitation may be enhanced when performed in combination with work hardening or work conditioning. If prognosis for return to former occupation is poor, except in the most extenuating circumstances, vocational assessment should be implemented within 3 to 12 months post-injury. Declaration of maximum medical improvement should not be delayed solely due to lack of attainment of a vocational assessment.

- ❖ Frequency: 1 time with additional visits as needed for follow-up.

e. **Work Tolerance Screening (Fitness for Duty)**

Work Tolerance Screening (Fitness for Duty) is a determination of an individual's tolerance for performing a specific job as based on a job activity or task. It may include a test or procedure to specifically identify and quantify work-relevant cardiovascular demands, physical fitness, and postural tolerance. It may also address ergonomic issues affecting the patient's return-to-work potential. May be used when a full Functional Capacity Evaluation is not indicated.

## F. SPECIFIC MUSCULOSKELETAL DIAGNOSIS, TESTING & TREATMENT PROCEDURES

Cumulative trauma related conditions comprise a number of specific diagnoses with diagnostic findings and treatment. Cumulative trauma disorder itself is not a diagnosis and cannot be treated or evaluated until the specific diagnosis is identified. Refer to Section C Definitions and Mechanisms of Injury for details.

Cumulative trauma conditions often involve several diagnoses and conservative treatment of all applicable diagnoses should be treated simultaneously. See Section G for peripheral neuropathies.

### 1. AGGRAVATED OSTEOARTHRITIS OF THE DIGITS, HAND OR WRIST

- a. **Description/Definition:** internal wrist joint pathology accompanied by cartilage loss. Pain usually in the carpometacarpal joints or in the metacarpophalangeal joints.
- b. **Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections.
- c. **Specific Physical Exam Findings:** The most common joint affected is the first carpometacarpal joint. The thumb metacarpophalangeal joint may also be involved.
  - i. Required findings are at least one of the following:
    - A) Positive grind test: The “grind test” consists of applying an axial load to the first metacarpal and rotating it medially and laterally. A positive test results in pain and/or crepitus;
    - B) Subluxation of the metacarpal may be induced in advanced cases;
    - C) Tenderness with palpation of thumb carpometacarpal or metacarpophalangeal joint.
  - ii. Additional findings may include:
    - A) Swelling;
    - B) Reduced motion; and
    - C) Angular deformities ([Young, Papp, & Giachino, 2007](#)).

When a patient presents with pain at the base of the thumb, tests for de Quervain's, flexor carpi radialis tendonitis, and scaphoid pathology should all be considered.

d. **Diagnostic Testing Procedures:** X-ray, diagnostic injection and/or aspiration, and MRI can be done if space occupying lesions are suspected. X-ray findings do not necessarily correlate with symptomatic arthritis.

e. **Non-operative Treatment Procedures:**

i. **Initial Treatment:** Splinting may be used nocturnally and for protection during specific activities. Wrist splinting should maintain neutral mechanics to avoid nerve stretch or ligamentous changes. There is good evidence that custom splints used nocturnally for 1 year decrease pain and increase function ([Rannou et al., 2009](#)). Historically, both hand-based and forearm-based splints have been used effectively and the type of splint should probably be based on patient preference as this will also influence long-term compliance ([J. Yao & Park, 2008](#)).

There is some evidence that home-based hand exercises with phone call follow-up and monitoring plus hand osteoarthritis (HOA) information is more effective than only giving HOA information in improving hand functionality in women with HOA ([Hennig et al., 2015](#)). Self-application of heat or ice and ergonomic changes of the job site are recommended.

ii. Medications such as analgesics (including NSAIDs) and over the counter medications for symptomatic relief may be helpful. Topical salicylates and nonsalicylates have been shown to be effective in relieving pain in acute and chronic musculoskeletal conditions. There is good evidence that diclofenac gel reduces pain and improves function in mild-to-moderate hand osteoarthritis ([Altman et al., 2009](#)). Diclofenac gel has been FDA approved for acute pain due to minor strains, pains, and contusions and for relief of pain due to osteoarthritis of the joints amenable to topical treatment, such as those of the knees and hands (Food and Drug Administration). There is some evidence that topical ketoprofen patches are more effective than placebo in reducing pain of upper extremity tendonitis; however, the need for continuous skin application may limit overall use ([Mazieres, Rouanet, Guillon, Scarsi, & Reiner, 2005](#)). Use of ketoprofen topical patch for the disorders described in these Guidelines has not been FDA approved at the time these Guidelines were written. Liver enzymes should be monitored when using topical or oral NSAIDs.

Refer to medication discussions in Section H.7 Medications and Medical Management for further details.

- iii. Patient education: should include instruction in self-management techniques, ergonomics, and home therapy program. One study demonstrated a 70% reduction in the number of patients desiring surgery when they were provided with 3 sessions of hand therapy explaining the use of splints; accessories such as fitted scissors, book support, pen handles; and modification of their work environment. It is strongly suggested that all patients receive hand therapy support before considering surgery, especially if the job requirements place a high demand on fine hand activities ([Berggren, Joost-Davidsson, Lindstrand, Nylander, & Povlsen, 2001](#)). Episodes of recurrence are common, so patient education regarding provocative activities is essential for long term recovery.
- iv. Job site evaluations and alterations: Ergonomic alterations should be done early to assure that appropriate changes are accomplished early in the treatment program.

Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite. Employers should consider applying the ergonomic changes to uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and Alterations and Section H.6 Job Site Alteration.

- v. Steroid injections: may decrease inflammation and allow the therapist to progress with rehabilitation therapy. Steroid injections under significant pressure should be avoided, as the needle may be penetrating the tendon and injection into the tendon can cause possible tendon breakdown, tendon degeneration, or rupture. Steroid injections may be useful in early stage osteoarthritis when used with a splint ([Van Heest & Kallemeier, 2008](#)).

- ❖ Time to Produce Effect: 1 to 2 injections. If the first injection is unsuccessful and symptoms continue, the second injection should be performed by a specialist with expertise in the anatomy of the upper extremity.
- ❖ Optimum Maximum Frequency: 3 injections in 1 year spaced at least 4 to 8 weeks apart.

- ❖ Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections. Refer to Section H.4 Injections for further information on steroid injections.
  - vi. Viscosupplementation/Intracapsular acid salts involve the injection of hyaluronic acid and its derivatives into the joint space. Hyaluronic acid is secreted into the joint space by the healthy synovium and has functions of lubrication and cartilage protection.
  - vii. There is no evidence that hyaluronate injections are superior to steroid injections for carpometacarpal thumb arthritis ([Figen Ayhan & Ustun, 2009](#); [Fuchs, Monikes, Wohlmeiner, & Heyse, 2006](#); [Heyworth et al., 2008](#); [Monfort et al., 2015](#); [Roux et al., 2007](#); [Stahl, Karsh-Zafir, Ratzon, & Rosenberg, 2005](#)). There is some evidence that intra-articular hyaluronan is not superior to placebo for improving pain in the setting of carpometacarpal osteoarthritis. There is also some evidence that intra-articular hyaluronan does not improve function in a clinically important way in the first six months after injection (([Mandl et al., 2012](#))). Therefore, they are **not recommended**.
  - viii. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work.
  - ix. Other therapies in Section H Therapeutic Procedures – Non-operative may be employed in individual cases.
- f. **Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.
- i. The patient may be a good surgical candidate when functional deficits interfere with activities of daily living and/or job duties after at least 3 months of active patient participation in non-operative therapy including job site changes, medication, injections, and splints.  
  
One study demonstrated a 70% reduction in the number of patients desiring surgery after 7 months when they were provided with 3 sessions of hand therapy explaining the use of splints; accessories such as fitted scissor, book support, pen handles; and modification of their work environment. It is strongly suggested that all patients

receive hand therapy support and job site alterations before considering surgery ([Berggren et al., 2001](#)).

ii. Thumb carpometacarpal joint arthritis

Early stage arthritis with functional deficits may be amenable to debridement and thermal capsular shrinkage. For later stages, synthetic material and interposition materials may have more complications than biologicals ([J. E. Adams, 2014](#)).

- A) Due to the complexity of the wrist joint and the lack of clear superiority of any one procedure, the choice of the type of procedure for an individual patient must be made on a case-by-case basis by the surgeon and patient.

There is currently a lack of convincing evidence that any operative intervention for osteoarthritis of the base of the thumb is more or less effective than any other operative intervention ([Cochrane] [Wajon, Vinycomb, Carr, Edmunds, & Ada, 2015](#)).

The most common current procedures for thumb carpometacarpal arthritis are trapeziectomy with or without suspension procedures, including ligament reconstruction and/or tendon interposition. There is good evidence that these procedures have similar outcomes at 1 year ([Belcher & Nicholl, 2000](#); [Davis, Brady, & Dias, 2004](#)). There is uncertainty regarding the risk of adverse events between simple trapeziectomy and trapeziectomy combined with other procedures. However, a lower risk of complications with simple trapeziectomy cannot be ruled out ([Cochrane] [Wajon et al., 2015](#)). Osteotomies may be additional procedures in some cases and fusions are occasionally performed, usually in younger active patients.

Ligament and tendon procedures are thought to protect the other carpal joints from earlier deterioration and allow greater stability for the thumb ([Martou, Veltri, & Thoma, 2004](#)) ([Forthman, 2009](#)). Most patients have not been followed long enough to compare rates of subsequent arthritis and resulting functional deficits between those having a simple trapeziectomy and those with suspension procedures. In one follow up study, there was an increase in x-ray joint changes without a clinical impact ([Salem & Davis, 2014](#)).

- B) The use of implants or spacers remains highly controversial. Most long-term studies of these have shown unacceptable levels of subsidence, subluxation or breakage ([B. D. Adams, Pomerance, Nguyen, & Kuhl, 2009](#); [Forthman, 2009](#); [Weiss, Kamal, & Shultz, 2013](#)). Due to the lack of evidence, implant procedures should only be considered after a second opinion by a hand surgeon specializing in the techniques and thorough understanding of the patient regarding expectation from the procedure, recovery time, and possible complications.
- iii. Arthritis at other joints: Scaphotrapezio-trapezoid joint arthritis resistant to conservative treatment is usually treated with fusion, although trapezoidectomy has also been used ([Wolf, 2008](#)). Fusion may be recommended for thumb metacarpophalangeal arthritis when surgery is necessary ([Day & Ramirez, 2006](#); [Shin & Osterman, 2008](#)).
- iv. Prior to surgical intervention, the patient and treating physician should identify functional operative goals and the likelihood of achieving improved ability to perform activities of daily living or work, as well as possible complications. The patient should agree to comply with the pre- and post-operative treatment plan, including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.
- v. Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time, without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.
- vi. Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

- g. Operative Procedures:** Arthroscopic trapeziectomy with or without suspension procedures including ligament reconstruction and/or tendon transposition; trapezoidectomy; fusion; osteotomy.

Complications from wrist arthroscopy are approximately 4.7%, including ulnar or posterior interosseous nerve damage ([Ahsan & Yao, 2012](#)). Total wrist arthroplasty is not currently recommended due to long-term problems with dislocation or compartment loosening ([Weiss et al., 2013](#)). If it is being considered, then prior authorization and a second opinion by a hand surgeon are required.

**h. Post-operative Treatment**

- i. An individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-operative. In all cases, communication between the physician and the therapist is important to the timing of exercise progressions.
- ii. Hand therapy should be started early to prevent loss of motion in adjacent joints. Treatment may include the following: splinting, restricted activities and other active therapy with or without passive therapy. Exact treatment regimes are based on the surgeon's recommendation and may include other therapies from Section H Therapeutic Procedures – Non-operative.
- iii. There is some evidence that in the post-operative management at one year following trapeziometacarpal (TMC) arthroplasty, there is no significant difference in pain, function, range of motion, or grip strength between patients who wore standard rigid orthoses and patients who wore semi-rigid orthoses from 2 to 6 weeks following TMC arthroplasty ([Prosser et al., 2014](#)).
- iv. Continuous passive motion after metacarpophalangeal joint arthroplasty is not supported by scientific evidence and therefore is ***not recommended***.
- v. Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon.



## 2. DE QUERVAIN'S DISEASE

- a. **Description/Definition:** Pain and swelling in or over the first dorsal extensor compartment (anatomical snuffbox) and/or over the radial styloid; pain radiating into the hand and forearm; pain worsened by thumb abduction and/or extension ([Batteson, Hammond, Burke, & Sinha, 2008](#)). May be caused by thickening of the extensor tendons and extensor retinaculum rather than inflammation ([Ilyas, Ast, Schaffer, & Thoder, 2007](#)).
- b. **Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections of this guideline.
- c. **Specific Physical Exam Findings:** de Quervain's disease affects the first dorsal extensor compartment.
- i. Required elements for diagnosis of de Quervain's disease are at least one of the following:
- A) Pain worsened by resisted thumb abduction and/or extension with or without resistance;
  - B) Positive Finkelstein's: The Finkelstein test is positive when localized pain results from ulnar wrist deviation with the thumb adducted;
  - C) Positive Stress Finkelstein's: Finkelstein's maneuver with pressure over the abductor pollicis longus.
- ii. Other possible exam findings include:
- A) Positive Eichhoff-thumb clinched in fist followed by wrist ulnar movement ([Ilyas et al., 2007](#));
  - B) Positive Tinel's may be present over the superficial radial sensory nerve;
  - C) Crepitus may be present, and tenderness over the first dorsal compartment is common ([Boocock et al., 2009](#); [Walker-Bone & Cooper, 2005](#)).
  - D) Less common and examiner-dependent findings include thickening of the first dorsal tendon sheath, swelling in the same area.

- d. **Diagnostic Testing Procedures:** X-ray and other imaging may be performed to rule out other differential diagnoses or when there is an indication that additional pathology, such as a space-occupying lesion, may be present. Electrodiagnostic testing can be considered to rule out neurological sources of pain.
- e. **Non-operative Treatment Procedures:**
- i. Initial Treatment: over-the-counter medications for symptomatic relief, thumb spica, splint or cast, ice, contrast baths and restriction of activities.
  - ii. Patient education: should include instruction in self-management techniques, ergonomics, and a home therapy program. Episodes of recurrence are common, so patient education regarding provocative activities is essential for long term recovery.
  - iii. Job site evaluations and alterations: Ergonomic alterations should be done early to assure the appropriate changes are accomplished early in the treatment program.

Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite. Employers should consider applying the ergonomic changes to uninjured workers in the same job position. Generally, patients should avoid repetitive thumb or wrist movements, grasping, and wrist ulnar deviation ([B. M. Huisstede, Coert, Friden, & Hoogvliet, 2014](#)). Refer to Section E.6.c Job Site Evaluations and Section H.6 Job Site Alteration.

- iv. Steroid injections: The proceduralist must exercise caution as the needle may disrupt the tendon and injection into the tendon can cause possible tendon breakdown, tendon degeneration, or rupture.

Observational studies suggest that steroid injections may be beneficial even when splints are not used. However, there is insufficient evidence to favor steroid injections over thumb spica splinting ([Cochrane] ([Peters-Veluthamaningal, van der Windt, Winters, & Meyboom-de Jong, 2009](#))). There is some evidence that in the setting of de Quervain's disease, functional benefits of a corticosteroid injection are enhanced by a thumb spica cast which reduces stress on the abductor pollicis longus and extensor pollicis

brevis tendons. There is inadequate evidence to show that a thumb spica cast, compared to other splinting methods, is necessary to achieve this added benefit ([Mardani-Kivi et al., 2014](#)). There is not clear evidence that steroid injections are more effective than splinting alone ([Ashraf & Devadoss, 2014](#)).

These injections are best performed by a specialist ([Graham, Hulkower, Bosworth, White, & Gauer, 2007](#); [Zingas, Failla, & Van Holsbeeck, 1998](#)). Ultrasound guided injections may assist when a separation is present between the extensor pollicis brevis and the abductor pollicis longus although there is insufficient evidence to routinely recommend this treatment ([Kume et al., 2012](#)).

Post injection, the hand is usually placed at rest for several days and a splint may be used ([B. M. Huisstede, Coert, et al., 2014](#)).

- ❖ Time to Produce Effect: 1 to 2 injections. If the first injection is unsuccessful and symptoms continue, the second injection should be performed by a specialist with expertise in the anatomy of the upper extremity.
- ❖ Optimum Frequency: 3 injections in 1 year spaced at least 2 to 8 weeks apart injection.
- ❖ Maximum Frequency: 4 per year if injections result in functional benefit without local reactions or complications.

Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections. Refer to Section H.4.c Steroid Injections for further details.

- v. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work.
- vi. Other therapies in Section H Therapeutic Procedures – Non-operative may be employed in individual cases.

- f. **Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.

First extensor compartment release is rarely necessary. Most cases resolve spontaneously over a number of months ([Ilyas, 2009](#)). Surgery may be performed to achieve functional gains for those with the required diagnostic exam findings who continue to have significant ongoing impaired activities of daily living after 8 weeks of treatment which include job modifications, injections, and other therapy.

There is some evidence that endoscopic and open release result in equally satisfactory 24 week outcomes and approximately equal return to work times for de Quervain's tenosynovitis. However, with endoscopic release there is a lower risk of transient injury to the superficial radial nerve, better scar satisfaction, and a slightly more rapid resolution of pain and functional limitations ([Kang, Koh, Jang, & Choi, 2013](#)).

Prior to surgical intervention, the patient and treating physician should identify functional operative goals and the likelihood of achieving improved ability to perform activities of daily living or work, as well as possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.

Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.

Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to

Section H.7.f Smoking Cessation Medications and Treatment for further details.

- g. **Operative Procedures:** first extensor compartment release, open or endoscopic. Complications may include: radial sensory nerve injury, volar subluxation of tendon, and infection (Ilyas, 2007 ([Ilyas et al., 2007](#))).
- h. **Post-operative Treatment:**
  - i. An individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-operative. In all cases, communication between the physician and therapist is important to the timing of exercise progression. Treatment may include the following: elevating the hand and moving fingers to prevent scar adhesions, splinting to rest hand and decrease thumb activity, and other active therapy with or without passive therapy ([B. M. Huisstede, Coert, et al., 2014](#)).
  - ii. Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon.

REFERENCED

3. **EPICONDYLITIS (EPICONDYLALGIA) – LATERAL AND MEDIAL**

- a. **Description/Definition - Lateral Epicondylitis:** Lateral epicondylitis is also known as tennis elbow, lateral elbow pain, rowing elbow, tendonopathy of the common extensor origin, and peri-tendonopathy of the elbow. It is characterized by elbow pain and tenderness over the lateral epicondyle of the humerus. Patients describe tenderness to palpation slightly anterior and distal to the lateral epicondyle and/or over the bony prominence of the lateral epicondyle. Patients frequently complain of pain with grasping when the elbow is extended and pronated.
- b. **Description/Definition - Medial Epicondylitis:** pain emanating from the medial elbow; mild grip weakness; medial elbow pain exacerbated by repetitive wrist extensions or forward flexion.
- c. **Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections.
- d. **Specific Physical Exam Findings - Lateral Epicondylitis:**
- i. Required elements for the diagnosis of lateral epicondylitis are as follows:
    - A) The patient must report tenderness to palpation at/near lateral epicondyle; and
    - B) In addition, at least one of the following examiner maneuvers must result in pain over the lateral epicondyle and/or extensor mass of the forearm:
      - Active or resisted wrist extension;
      - Active or resisted middle finger extension;
      - Active or resisted supination.
  - ii. Pain may also increase with gripping. Swelling, erythema, and warmth are generally not seen in this condition.
- e. **Specific Physical Exam Findings - Medial Epicondylitis:**
- i. Required elements for the diagnosis of medial epicondylitis are as follows:

- A) The patient must report tenderness to palpation at/near medial epicondyle; **and**
- B) In addition, at least one of the following examiner maneuvers must result in pain over the medial epicondyle and/or flexor mass of the forearm:
- Active or resisted wrist flexion;
  - Active or resisted long finger flexion;
  - Active or resisted pronation.
- ii. The exam may include elements for diagnosing cubital tunnel syndrome if appropriate.
- f. **Diagnostic Testing Procedures:** The clinical diagnosis of epicondylitis is made by the combination of patient complaints and required objective physical findings. Additional studies such as plain radiographs, MRI, and sonogram examinations are not routinely ordered to establish the diagnosis of epicondylitis. However, these studies may be used to rule out other conditions that may produce similar symptoms, including radial tunnel syndrome, cervical radiculopathy, osteochondral radiocarpal lesion, posterolateral elbow plica, and posterolateral elbow instability. X-rays may be normal or demonstrate spur formation over the involved epicondyle.

Electrodiagnostic studies can be considered to rule out neurological sources of pain, such as radial tunnel syndrome or posterior interosseous nerve entrapment.

g. **Non-operative Treatment Procedures:**

- i. **Initial Treatment:** over-the-counter medications for symptomatic relief, ice, bracing, and restriction of activities. Topical NSAIDs are commonly used, although there is no evidence that topical or oral NSAIDs are effective ([Cochrane] ([Pattanittum, Turner, Green, & Buchbinder, 2013](#))).

Literature indicates that over 80% of patients with greater than 4 weeks of pain recovered by 1 year ([BMJ Clinical Evidence] ([Ashworth, 2015](#))). The natural history of epicondylitis supports an expectation of improvement within 3 months of using patient education and modified activities ([L. Bisset et al., 2006](#)).

- ii. Patient education: should include instruction in self-management techniques, ergonomics, and home therapy program ([L. Bisset et al., 2006](#)). Episodes of recurrence are common, so patient education regarding provocative activities is essential for long term recovery.
- iii. Bracing: The rationale for braces is to rest the wrist extensor or flexor muscles while reducing tension at the extensor or flexor origin, allowing healing of the muscle and tendon.

Brace types include proximal forearm band/sleeve, cock-up wrist splint, forearm/hand splint, and dynamic extensor brace.

Braces may be used in patients who are able to tolerate wearing the brace during activity and do not experience worsening pain and/or additional symptoms due to brace, but should be discontinued in the event of adverse effects.

There is no evidence that one brace type is superior to other types ([L. M. Bisset, Collins, & Offord, 2014](#); [Forogh et al., 2012](#); [Garg, Adamson, Dawson, Shankwiler, & Pink, 2010](#); [Struijs et al., 2002](#)). However, some brace types may be impractical for use in most workers. For example, surgical technicians and food handlers would be unable to use most braces involving the wrist due to incompatibility with occupational function. The forearm band brace type appears to be the least cumbersome brace option and may be the best tolerated. However, this brace has the disadvantage of sometimes putting pressure on the radial nerve or occasional incorrect use by the patient.

Selecting the appropriate brace type is a decision that should be made by both patient and treating physician or therapist and should include appropriate patient education and follow-up. Braces which restrict range of motion should not be used continuously as this may result in permanent loss of motion. Compression straps should not be positioned in a manner which would irritate branches of the radial nerve. Braces should achieve maximum function and patient comfort.

- iv. Job site evaluations and alterations: Ergonomic alterations should be done early to assure the appropriate changes are accomplished early in the treatment program.

Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty



changes; and/or 3) a formal job site evaluation at the worksite. Employers should consider applying the ergonomic changes to uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and Section H.6 Job Site Alteration.

- v. Steroid injections: may decrease inflammation, pain, and allow the therapist to progress with rehabilitation therapy.

Steroid injections under significant pressure should be avoided as the needle may be penetrating the tendon and injection into the tendon can cause possible tendon breakdown, tendon degeneration, or rupture.

There is strong evidence that in the setting of lateral epicondylitis, the effects of corticosteroid injections on pain and function are more favorable than placebo in the first four weeks, but these benefits are reversed by six months and are detrimental compared to placebo injections in the intermediate and long term ([Arik et al., 2014](#); [Coombes, Bisset, & Vicenzino, 2010](#); [Kucuksen, Yilmaz, Salli, & Ugurlu, 2013](#); [Mardani-Kivi et al., 2013](#); [Peerbooms, Sluimer, Bruijn, & Gosens, 2010](#)). Thus, injections for epicondylitis must include a discussion with the patient regarding lack of long-term benefits compared to no injection, as well as the need to combine other therapy, including a slow increase of activities that aggravate the condition. Steroid injections do provide short term benefit and may be considered an adjunctive therapy for some patients.

- ❖ Time to Produce Effect: 1 to 2 injections. If the first injection is unsuccessful and symptoms continue, the second injection should be performed by a specialist with expertise in the anatomy of the upper extremity.
- ❖ Optimum Frequency: 3 injections in 1 year spaced at least 2 to 8 weeks apart.
- ❖ Maximum Frequency: 3 to 4 per year if injections result in functional benefit without local reactions or complications.

Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections. Refer to Section H.4.c Steroid Injections for further details.

- vi. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work.
- vii. Botulinum toxin injection: The rationale for botulinum toxin treatment is that it reversibly paralyzes the extensor muscles and thereby prevents repetitive micro-trauma of the tendonous fibers at their origin from the osseous lateral epicondyle. The unit dosage varies significantly depending on the brand used. Usage for lateral and medial epicondylitis is not FDA approved at the time of these Guidelines writing. There is good evidence that botulinum toxin can alleviate the pain of lateral epicondylitis in the short term, with significant but reversible extensor weakness ([Espandar et al., 2010](#)). However, the long-term consequences and functional benefits are unknown. There is also good evidence that botulinum toxin A injections cause weakness in finger extension and/or digit paresis. Additional complications may include: allergic reaction to medications, increased risk of systemic effects in patients with motor neuropathy or disorders of the neuromuscular junction ([Espandar et al., 2010](#); [Placzek, Drescher, Deuretzbacher, Hempfing, & Meiss, 2007](#); [Wong et al., 2005](#)).

Botulinum toxin injection is known to cause short-term third (middle) finger strength deficits and possible digit paresis, which may persist for up to 3 to 4 months ([Espandar et al., 2010](#); [Placzek et al., 2007](#); [Wong et al., 2005](#)). Botulinum toxin injection should only be used in patients whose occupational performance will be unaffected by this side effect, and should not be used in patients with physically demanding job descriptions.

It should not be considered a first line of treatment. Other conservative measures should be tried first. A single botulinum toxin type A injection may provide pain reduction for up to 3 to 4 months in patients with chronic lateral epicondylitis which has persisted after 3 months of treatment.

Botulinum toxins are manufactured at different potencies, and units of the different manufacturers are not equivalent. Careful botulinum toxin dosing should be used to avoid complete paresis and allow maintained functionality and return to work.

The decision to use botulinum toxin for pain relief from chronic lateral epicondylitis symptoms should be made carefully by both patient and treating physician, with knowledge of the known side effects and consideration of the individual occupational demands of the patient.

Botulinum injection should only be performed by a physician or surgeon who has expertise in the anatomy of the upper extremity and who is experienced in the use of this agent. Ultrasound guidance may be helpful. **Prior authorization is required.**

- ❖ Maximum: One injection episode.

viii. Other injections:

A) Prolotherapy and polidocanol (sclerosing agent) have all been used in studies too small and/or inadequate to make any recommendations. Due to lack of evidence of their effectiveness and the cost involved, prolotherapy and polidocanol are **not recommended**.

B) Autologous Whole Blood Injections/Platelet-Rich Plasma Injections:

- 1) Autologous Whole Blood Injections: are relatively inexpensive treatments and may be used in patients who have not made sufficient functional progress with initial therapy for lateral or medial epicondylitis after 10 to 12 weeks ([Rabago et al., 2009](#)).

There is some evidence that, for patients with symptoms lasting 6 months or more, autologous blood injections result in better pain and functional outcomes after 1 year than steroid injections ([Ozturan, Yucel, Cakici, Guven, & Sungur, 2010](#)).

- ❖ Optimum Frequency: 2 injections may be required.

- 2) Platelet-Rich Plasma Injections: There is good evidence that, for patients with symptoms lasting 6 months or more, platelet-rich plasma injections result in better pain and functional outcomes after 1 year than steroid injections ([Peerbooms et al., 2010](#)).

There is good evidence that in the setting of lateral epicondylitis, platelet-rich plasma injections may lead to a small to moderate functional benefit in comparison to autologous whole blood or saline at two to three months, but effects on pain are uncertain

([Cochrane] ([Moraes, Lenza, Tamaoki, Faloppa, & Belloti, 2013](#))).

There is good evidence that platelet-rich plasma injections produces more favorable symptomatic and functional improvement than triamcinolone injection in patients with chronic lateral epicondylitis, with this advantage persisting for 24 months after treatment ([Gosens, Peerbooms, van Laar, & den Oudsten, 2011](#)).

In summary, there is strong evidence for the use of platelet-rich plasma in patients who have not improved with conservative therapy.

- ❖ Optimum Frequency: 2 injections may be required.

- ix. There is no clinical evidence or sound physiologic rationale for magnets or diathermy, therefore, they are **not recommended**.
- x. Low Level Laser: There is good evidence that low level laser is not more effective than placebo for lateral epicondylitis ([L. Bisset, Paungmali, Vicenzino, & Beller, 2005](#)), and its use is **not recommended**.
- xi. Extracorporeal shock wave therapy (ESWT): The natural history of epicondylitis supports an expectation of improvement within 3 months using patient education and modified activities([L. Bisset et al., 2006](#)). There is some evidence that highly motivated tennis players may show up to a 35% additional improvement over no other treatment when administered low energy shock wave treatment without local anesthesia ([Rompe, 2004](#)). Two other studies are not of sufficient quality to qualify as evidence ([Ozturan et al., 2010](#); [Spacca, Necozone, & Cacchio, 2005](#)). There is some evidence that three weekly sessions of radial ESWT and sham ESWT lead to statistically similar symptomatic and functional outcomes at three months([Capan et al., 2016](#)). However, a benefit of radial ESWT cannot be ruled out due to uncertainties in the data. The preponderance of evidence does not support the efficacy of ESWT in the working population; therefore, it is **not recommended**.
- xii. Acupuncture: There is some evidence that acupuncture has a very short term 2 week effect on pain compared to sham acupuncture for

lateral epicondylitis ([Fink et al., 2002](#)). The patients may request this treatment. Refer to Section H.1 Acupuncture for more information.

xiii. Other therapies in Section H Therapeutic Procedures – Non-operative may be employed in individual cases.

A) Topical Glyceryl Trinitrate: There is some evidence from a small study that wearing a topical patch containing glyceryl trinitrate over an area of tendinopathy is more effective than a placebo patch in reducing pain and improving overall clinical recovery in subjects with lateral epicondylitis over a period of 6 months ([Ozden, Uruc, Dogramaci, Kalaci, & Yengil, 2014](#)). However, improvement in function was not clearly demonstrated. There is also some evidence that topical glyceryl trinitrate is not effective for lateral epicondylitis from a study demonstrating no benefit compared to placebo with varied doses ([Paoloni, Murrell, Burch, & Ang, 2009](#)). Side effects include headaches. The patch must be applied every day. Therefore it is **not generally recommended** and may only be used if there is failure of other conservative care at 8-12 weeks.

B) Ultrasound with corticosteroids (phonophoresis) and iontophoresis may be used occasionally to facilitate other therapy, but there is no evidence that they alter long-term function ([L. Bisset et al., 2005](#); [Nirschl, Rodin, Ochiai, Maartmann-Moe, & Group, 2003](#); [Smidt et al., 2002](#)). Thus these passive treatments may be used on a limited basis.

A systematic review of low quality studies found a lack of evidence for the effectiveness of ultrasound, laser, pulsed electromagnetic field therapy, TENS, and extracorporeal shock wave for the treatment of lateral epicondylitis ([Dingemans, Randsdorp, Koes, & Huisstede, 2014](#)). Therefore, they are *not recommended*. However, high volt or interferential may be useful in some patients.

ix. Physical Therapy, Mobilization, and Manipulation:

This subsection reviews the evidence base for using physical therapy, including mobilization and manipulation, in the treatment of epicondylitis.

There is good evidence that there are early benefits from an 8 week program of weekly, individualized physical therapy for patients who do

not receive a corticosteroid injection. However, the natural history of the condition tends to obscure these early benefits at one year from the time therapy begins ([Coombes, Bisset, Brooks, Khan, & Vicenzino, 2013](#)).

There is some evidence that for subjects with long-term lateral epicondylalgia, a daily 6-week eccentric home exercise regimen is effective in increasing pain-free hand-grip, increasing wrist-extensor strength, and reducing the number of cases that meet the diagnostic criteria for lateral epicondylalgia ([Soderberg, Grooten, & Ang, 2012](#)).

There is some evidence that the addition of Mulligan mobilization to a regimen comprising of ultrasound therapy and progressive exercises is more effective in decreasing pain and increasing pain-free grip strength than ultrasound therapy and progressive exercises alone in the treatment of lateral epicondylitis ([Kochar & Dogra, 2002](#)).

Although one Cochrane found inadequate evidence to support deep transverse friction massage alone ([Cochrane] [Loew et al., 2014](#)), another study is supportive of deep tissue massage combined with manipulation ([Nagrle, Herd, Ganvir, & Ramteke, 2009](#)). There is some evidence that both Cyriax physiotherapy (deep transverse friction massage combined with Mills manipulation) and phonophoresis with supervised exercise and static stretching are effective over a period of 4 weeks of treatment for lateral epicondylalgia in decreasing pain, increasing pain-free grip strength, and improving functional status. However, Cyriax physiotherapy provides a superior benefit compared to phonophoresis with supervised exercise and static stretching ([Nagrle et al., 2009](#)).

The muscle energy technique is a manual therapy technique in which the patient performs voluntary contraction against a counter force from the provider to stretch muscles and improve range of motion. There is some evidence that the muscle energy technique is superior to corticosteroid injection in improving grip strength in lateral epicondylitis ([Kucuksen et al., 2013](#)). However, it is not clear that the technique is better than no treatment.

There is good evidence that manual and manipulative therapy combined with exercise and/or multimodal therapy shows small, clinically important reductions in pain and improved physical function in the short-term care ( $\leq 3$ -6 months) of patients with lateral epicondylitis and carpal tunnel syndrome ([Brantingham et al., 2013](#)).

There is good evidence that physical therapy using manipulation, home exercise and supervised exercise reduced pain at 6 weeks but not at 52 weeks ([L. Bisset et al., 2006](#)). This may be appropriate therapy to hasten return to work.

In summary, physical therapy including manual and manipulative therapy is encouraged based on good evidence.

- ❖ Time to Produce Effect: 4 treatments.
- ❖ Optimum Frequency: 12 treatments over 6 weeks.

**h. Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.

Lateral epicondyle release/debridement is generally accepted; however, over 80% of cases improve with conservative therapy only ([L. Bisset et al., 2006](#); [Gellman, 2008](#); [Haahr & Andersen, 2003](#)). Intermittent discomfort may recur over 6 months to 1 year after initial conservative treatment.

The patient may be a good surgical candidate when the diagnosis is confirmed on physical exam (Refer to Section D.1.d Physical Examination) and functional deficits interfere with activities of daily living and/or job duties after at least 3 months of active patient participation in non-operative therapy including worksite changes, medication, splints, and injections or other therapy noted above.

Prior to surgical intervention, the patient and treating physician should identify functional operative goals, the likelihood of achieving improved ability to perform activities of daily living or work, and possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.

Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time, without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.

Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

- i. **Operative Procedures:** Lateral or medial epicondyle release/debridement. There is good evidence that no specific surgical intervention is effective for lateral elbow pain ([Cochrane] ([Buchbinder et al., 2011](#))).
- j. **Post-operative Treatment:**
  - i. An individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-operative. In all cases, communication between the physician and therapist is important to the timing of exercise progressions. Treatment may include the following: splinting, and active therapy with or without passive therapy.
  - ii. Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon. Full return to normal activities usually occurs by approximately 3 months.



#### 4. **EXTENSOR TENDON DISORDERS OF THE DIGIT OR WRIST**

- a. **Description/Definition:** pain localized to the affected tendon(s) and muscles that is worsened by active and/or resisted wrist or finger extension. A number of specific disorders may occur including intersection syndrome and extensor carpi ulnaris tenosynovitis.
- b. **Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections.
- c. **Specific Physical Exam Findings:**
- i. Required elements for the diagnosis of extensor tendon disorders of the wrist are the following: pain and/or tenderness with active or resisted wrist/digit extension, specific to the extensor mechanism involved.
  - ii. Intersection Syndrome is due to the action of the extensor pollicis brevis and the abductor pollicis longus on the wrist extensors in the second dorsal compartment. It is frequently accompanied by a sandpaper appearance to the dermis. It is reproduced by wrist extension ([J. E. Adams & Habbu, 2015](#)).
  - iii. Extensor carpi ulnaris tenosynovitis is identified when resisted ulnar wrist deviation with forearm pronation or wrist extension with forearm supination reproduces the pain ([J. E. Adams & Habbu, 2015](#)).
  - iv. Other common findings include creaking/crepitus with wrist extension and swelling along the dorsal aspects of the hand/wrist/forearm.
- d. **Diagnostic Testing Procedures:** X-ray and other imaging may be also performed to rule out other differential diagnoses or when there is an indication additional pathology may be present.
- e. **Non-operative Treatment Procedures:**
- i. Initial Treatment: over-the-counter medications for symptomatic relief, wrist splints for wrist flexors and splinting.
  - ii. Patient education: should include instruction in self-management techniques, ergonomics, and a home therapy program. Episodes of recurrence are common so patient education regarding provocative activities is essential for long term recovery.

- iii. Job site evaluations and alterations: Ergonomic alterations should be done early to assure the appropriate changes are accomplished early in the treatment program.

Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite. Employers should consider applying the ergonomic changes to uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and Section H.6 Job Site Alteration.

- iv. Steroid Injections: may decrease inflammation, pain, and allow the therapist to progress with rehabilitation therapy. Steroid injections under significant pressure should be avoided as the needle may be penetrating the tendon and injection into the tendon can cause possible tendon breakdown, tendon degeneration, or rupture.

- ❖ Time to Produce Effect: 1 to 2 injections. If the first injection is unsuccessful and symptoms continue, the second injection should be performed by a specialist with expertise in the anatomy of the upper extremity.
- ❖ Optimum Frequency: 3 injections in 1 year spaced at least 2 to 8 weeks apart.
- ❖ Maximum Frequency: 3 to 4 per year if injections result in functional benefit without local reactions or complications.

Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections. Refer to Section H.4.c Steroid Injections for further details.

- v. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work.

- vi. Other therapies in Section H Therapeutic Procedures – Non-operative may be employed in individual cases.

- f. **Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity. Surgery is indicated when a tendon is ruptured, chronically enlarged or entrapped, or on rare occasions when conservative measures have failed and tendonitis is clearly present ([J. E. Adams & Habbu, 2015](#)).

Prior to surgical intervention, the patient and treating physician should identify functional operative goals, the likelihood of achieving improved ability to perform activities of daily living or work, and possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.

Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time, without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.

Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

- g. **Operative Procedures:** Tenosynovectomy, synovectomy, repair, and/or reconstruction of the extensor tendon.

h. **Post-operative Treatment:**

- i. An individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-operative. In all cases, communication between the physician and therapist is important to

the timing of exercise progressions. Treatment may include the following: splinting, and active therapy with or without passive therapy.

- ii. Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon.

## 5. **FLEXOR TENDON DISORDERS OF THE DIGIT OR WRIST**

- a. **Description/Definition:** pain and/or tenderness localized to the affected tendons; pain in the affected tendons associated with wrist/digit flexion and ulnar deviation, especially against resistance.
- b. **Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections.
- c. **Specific Physical Exam Findings:**
  - i. Required elements for the diagnosis of general wrist or digit flexion tendon disorders include one of the following:
    - A) Reproduction of pain with active or resisted wrist/digit flexion;
    - B) Ulnar deviation specific to flexor mechanism involved; or
    - C) Flexor carpi radialis may present with accompanying radial volar wrist pain with resisted wrist flexion and radial deviation ([J. E. Adams & Habbu, 2015](#)).
  - ii. Crepitus with active motion of the flexor tendons may also be present.
- d. **Diagnostic Testing Procedures:** X-ray and other imaging may be also performed to rule out other differential diagnoses or when there is an indication additional pathology may be present.
- e. **Non-operative Treatment Procedures:**
  - i. **Initial Treatment:** over-the-counter medications for symptomatic relief, wrist splints for wrist flexors and splinting.
  - ii. **Patient education:** should include instruction in self-management techniques, ergonomics, home therapy program and intermittent splinting for contractures. Recurrence is common, so patient

education regarding provocative activities is essential for long term recovery.

- iii. Job site evaluations and alterations: Ergonomic alterations should be done early to assure the appropriate changes are accomplished early in the treatment program.

Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite. Employers should consider applying the ergonomic changes to uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and Section H.6 Job Site Alteration.

- iv. Steroid Injections: may decrease inflammation and pain and allow the therapist to progress with rehabilitation therapy. Steroid injections under significant pressure should be avoided as the needle may be penetrating the tendon and injection into the tendon can cause possible tendon breakdown, tendon degeneration, or rupture.

- ❖ Time to Produce Effect: 1 to 2 injections. If the first injection is unsuccessful and symptoms continue, the second injection should be performed by a specialist with expertise in the anatomy of the upper extremity.

- ❖ Optimum Frequency: 3 injections in 1 year spaced at least 2 to 8 weeks apart.

- ❖ Maximum Frequency: 3 to 4 per year if injections result in functional benefit without local reactions or complications.

Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections. Refer to Section H.4.c Steroid Injections for further details.

- v. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return- to-Work.
- vi. Other therapies in Section H Therapeutic Procedures – Non-operative may be employed in individual cases. Refer to Section H.4.c Steroid Injections for further details.

- f. **Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.

Surgery is rarely necessary but may be indicated when a tendon is ruptured, chronically enlarged or entrapped, or on rare occasions when conservative measures have failed and tendonitis is clearly present ([J. E. Adams & Habbu, 2015](#)).

Any decision for surgical intervention should be based on a hand surgeon's evaluation of need and the existence of a clear functional deficit that can be corrected by surgical intervention.

Prior to surgical intervention, the patient and treating physician should identify functional operative goals, the likelihood of achieving improved ability to perform activities of daily living or work, and possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.

Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time, without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.

Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

- g. Operative Procedures:** The surgical procedures will depend on the specific condition and may include tenosynovectomy, synovectomy, or repair/reconstruction of the flexor tendon.
- h. Post-operative Treatment:**
- i. An individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-operative. In all cases, communication between the physician and therapist is important to the timing of exercise progressions. Treatment may include the following: splinting, and active therapy with or without passive therapy.
  - ii. Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon.

**6. TRIANGULAR FIBROCARTILAGE COMPLEX TEAR (TFCC)**

- a. Description/Definition:** pain and/or tenderness localized to the affected tendons; pain in the affected tendons associated with wrist/digit flexion and ulnar deviation, especially against resistance.
- b. Occupational Relationship:** This condition may be asymptomatic and then aggravate due to occupational exposures and require treatment. Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections.
- c. Specific Physical Exam Findings:**
- i. Required elements for the diagnosis of TFCC are:
    - A) Tenderness over the TFCC complex; and
    - B) One positive provocative test with localizing pain, clicking or findings of abnormal motion. Provocative tests include:
      - Forced supination and pronation with axial pressure on an ulnar deviated wrist;
      - The patient pushes up from a seating position using the hand; and/or

- Ballottement of the distal ulna with the wrist supinated causes abnormal motion as compared to the asymptomatic side.
- ii. Crepitus: clicking/popping are frequently present.
  - iii. Extensor or flexor carpi ulnaris tendinitis may also be confused with TFCC ([Szabo, 2007](#); [Young et al., 2007](#)).
- d. **Diagnostic Testing Procedures:** x-ray and MRI or MRI arthrography (MRA). There is good evidence that MRA is a more sensitive and more specific diagnostic test for TFCC than MRI. There is also good evidence that many patients who do not have TFCC can be more accurately identified with MRA rather than MRI ([Smith, Drew, Toms, Jerosch-Herold, & Chojnowski, 2012](#)). As with knee degenerative changes, many patients with TFCC tears are asymptomatic. In one study of patients with a history of TFCC and related falls, ligament disruptions were commonly found in the opposite asymptomatic hand over 50% of the time ([Cantor, Stern, Wyrick, & Michaels, 1994](#)). Therefore, it may be reasonable to also image the opposite wrist if it is asymptomatic. Those with a corresponding abnormality in the opposite wrist should have an especially rigorous diagnostic review before proceeding to a surgical intervention.
- e. **Non-operative Treatment Procedures:**
- i. Initial Treatment: rest, splinting, ice and later heat.
  - ii. Medications such as analgesics and over-the-counter medications for symptomatic relief may be helpful. Refer to medication discussions in Section H.7 Medications and Medical Management.
  - iii. Patient education: should include instruction in self-management techniques, ergonomics, and a home therapy program. Episodes of recurrence are common, so patient education regarding provocative activities is essential for long term recovery.
  - iv. Job site evaluations and alterations: Ergonomic alterations should be done early to assure the appropriate changes are accomplished early in the treatment program.

Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite.



Employers should consider applying the ergonomic changes to uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and H.6 Job Site Alteration.

- v. Steroid Injections: may decrease inflammation and pain and allow the therapist to progress with rehabilitation therapy. Steroid injections under significant pressure should be avoided as the needle may be penetrating the tendon and injection into the tendon can cause possible tendon breakdown, tendon degeneration, or rupture.
  - ❖ Time to Produce Effect: 1 to 2 injections. If the first injection is unsuccessful and symptoms continue, the second injection should be performed by a specialist with expertise in the anatomy of the upper extremity.
  - ❖ Optimum Frequency: 3 injections in 1 year spaced at least 2 to 8 weeks apart.
  - ❖ Maximum Frequency: 3 to 4 per year if injections result in functional benefit without local reactions or complications.

Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections.

- vi. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work.
- vii. Other therapies in Section H Therapeutic Procedures – Non-operative may be employed in individual cases. Refer to Section H.4.c Steroid Injections for further details.

- f. **Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.

A patient may be a surgical candidate if there are concomitant fractures, instability, or if symptoms continue to interfere with ADLs or job duties after non-surgical interventions for 2 to 3 months.

- i. Non-surgical interventions should include: rest from inciting factors, ergonomic job changes, and steroid injections. Pathology is usually

identified on MRI and there should not be another diagnosis which better explains the patient's complaints.

Those with a corresponding abnormality in the opposite wrist should have an especially rigorous diagnostic review before proceeding to a surgical intervention.

- ii. Prior to surgical intervention, the patient and treating physician should identify functional operative goals, the likelihood of achieving improved ability to perform activities of daily living or work, and possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.

Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time, without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.

Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

For both non-union and soft-tissue: Smokers have a higher risk of non-union and post-operative costs. Therefore, if a treating physician recommends a specific smoking cessation program peri-operatively, it should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels.

The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7 Medications for further details.

- g. Operative Procedures:** numerous procedures including arthroscopy debridement and/or repair, ulnar shortening and wafer procedure when there is a carpal detachment or detachment of the radius ([Bernstein, Nagle, Martinez, Stogin, & Wiedrich, 2004](#); [Szabo, 2007](#)). The surgical procedures will depend on the specific deficit.
- h. Post-operative Treatment:**

  - i. An individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-operative. In all cases, communication between the physician and therapist is important to the timing of exercise progressions. Treatment may include the following: splinting, and active therapy with or without passive therapy.
  - ii. Wrist splints are usually required for 6 weeks, and power grip and axial loading are discouraged. Range of motion is usually begun at 2 weeks ([Bernstein et al., 2004](#)).
  - iii. Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon. Usually light activity only is recommended for 3 months.

## **7. TRIGGER DIGIT**

- a. Description/Definition:** difficulty extending and flexing the digit which may be accompanied by a history of “catching” or “triggering.” Other conditions may be related to this complaint. Thus, history alone does not confirm the diagnosis.
- b. Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections.
- c. Specific Physical Exam Findings:** Required elements for the diagnosis of trigger digits include one of the following:

  - i. Tenderness at the A1 pulley with digit motion;

- ii. Triggering of the digit;
- iii. A history of difficulty flexing and extending the digit with a palpable nodule.

Active range of motion may be affected, usually only in severe cases.

**d. Diagnostic Testing Procedures:** X-ray and other imaging may be performed to rule out other differential diagnoses or when there is an indication that additional pathology may be present.

**e. Non-operative Treatment Procedures:**

- i. Initial Treatment: over-the-counter medications for symptomatic relief.
- ii. Orthosis: a metacarpal or proximal interphalangeal joint blocking splint for 3 – 6 weeks ([B. M. Huisstede, Hoogvliet, Coert, & Friden, 2014](#)).
- iii. Patient education: should include instruction in self-management techniques, ergonomics, and home therapy program. Recurrence is common, so patient education regarding provocative activities is essential for long term recovery.
- iv. Job site evaluations and alterations: Ergonomic alterations should be done early to assure the appropriate changes are accomplished early in the treatment program.

Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite. Employers should consider applying the ergonomic changes to uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and Section H.6 Job Site Alteration.

- v. Steroid injections for trigger digit provide decreased symptoms and are frequently a first line treatment ([Cochrane] ([Peters-Veluthamaningal et al., 2009](#))).

There is some evidence that in the intermediate term (up to three months), injections with triamcinolone and with diclofenac are equally effective in patients with trigger digit ([Shakeel & Ahmad, 2012](#)).

The patient should rest the digit partially or completely for 0 – 7 days after the injection ([B. M. Huisstede, Hoogvliet, et al., 2014](#)).

Steroid Injections: may decrease inflammation and pain and allow the therapist to progress with rehabilitation therapy. Steroid injections under significant pressure should be avoided as the needle may be penetrating the tendon and injection into the tendon can cause possible tendon breakdown, tendon degeneration, or rupture.

- ❖ Time to Produce Effect: 1 to 2 injections. If the first injection is unsuccessful and symptoms continue, the second injection should be performed by a specialist with expertise in the anatomy of the upper extremity.
- ❖ Optimum Frequency: 3 injections in 1 year spaced at least 2 to 8 weeks apart.
- ❖ Maximum Frequency: If additional injections are being considered, referral to a specialist should be considered.

Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections. Refer to Section H.4.c Steroid Injections for further details.

- vi. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work.
- vii. Other therapies in Section H Therapeutic Procedures – Non-operative may be employed in individual cases. Refer to Section H.4.c Steroid Injections for further details.

- f. **Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.

Surgery is often not necessary. Any decision for surgical intervention should be based on a hand surgeon's evaluation of need and the existence of a clear functional deficit that can be corrected by surgical intervention. Trigger digit release, open or percutaneous, may be indicated when: 1) diagnosis has been verified; and 2) symptoms persist after conservative management including steroid injections over at least 4 weeks. Surgery should be performed to

achieve functional gains on those with significant ongoing impaired activities of daily living or work-related functions. There is good evidence that open and percutaneous trigger digit release have similar success rates and similar complication rates (Wang, Zhao, & Liang, 2013). There is good evidence that percutaneous release has a lower rate of recurrence than does a steroid injection (Wang et al., 2013).

Prior to surgical intervention, the patient and treating physician should identify functional operative goals, the likelihood of achieving improved ability to perform activities of daily living or work, and possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.

Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.

Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

**g. Operative Procedures:** trigger digit release.

**h. Post-operative Treatment:**

i. An individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-operative. In all cases, communication between the physician and therapist is important to the timing of exercise progressions. Treatment may include the following: splinting, elevating the hand post-operatively, and active

therapy with or without passive therapy. Digital motion per surgeon's instructions will avoid scar formation.

- ii. Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon. Usually no heavy lifting or forceful activity for 2 – 4 weeks post-operatively ([B. M. Huisstede, Hoogvliet, et al., 2014](#)).

REFERENCED VERSION

## G. SPECIFIC PERIPHERAL NERVE DIAGNOSIS, TESTING & TREATMENT PROCEDURES

### 1. CARPAL TUNNEL SYNDROME

- a. **Description/Definition:** The median nerve is vulnerable to compression and injury in the region of the wrist and palm. In this area, the nerve is bound by the wrist bones and the transverse carpal ligament. The most common site of compression is at the proximal edge of the flexor retinaculum (an area near the crease of the wrist). Stenosing tenosynovitis may occur proximal and distal to the carpal tunnel area. There is often a myofascial component in the patient's presentation. This should be considered when proceeding with the diagnostic testing and therapeutic intervention.

The following elements are commonly associated with carpal tunnel syndrome:

- i. Exacerbating and alleviating factors of the reported symptoms. The physician should explore and report on non-work related, as well as work-related activities.
- ii. Prior occupational and non-occupational injuries to the same area including specific prior treatment and any prior bracing devices.
- iii. Discussion of any symptoms present in the unexposed extremity.



- b. **Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To properly assess causation, the reader must comply with all sections.
- c. **Non-Occupational relationship:** Hypothyroidism, diabetes types 1 and 2, and being overweight all are modest risk factors for carpal tunnel syndrome ([Pourmemari & Shiri, 2016](#); [Shiri, 2014, 2015](#); [Shiri, Pourmemari, Falah-Hassani, & Viikari-Juntura, 2015](#)). Obesity and a square shaped wrist also increase the probability of carpal tunnel in the wrist, with an odds ratio of around 2 ([Hlebs, Majhenic, & Vidmar, 2014](#)). However, causation should be determined by the assessment in these Guidelines. These additional factors may only be considered for cases not meeting the evidence based criteria. Pregnancy is a known risk factor with up to 20% experiencing symptoms which are more frequent in later pregnancy ([Khosrawi & Maghroui, 2012](#)).
- d. **Specific Physical Exam Findings:** No one test is predictive of carpal tunnel syndrome. Multiple tests should be recorded with the patient's exact response. Final diagnosis is dependent on a correlation of symptoms, physical exam findings, and nerve conduction velocity (NCV) testing as any of these alone may have a false positive or false negative result. Phalen's and Tinel's appear to have similar predictive values as the flick test, between 73 and 87% for the positive predictive value and negative predictive values between 35 and 40% ([Hansen, Micklesen, & Robinson, 2004](#)). Comparing physical exam findings to electrodiagnostic findings, Phalen's and Durkan's have an accuracy of 64-68% and weakness tests have a higher sensitivity ([Makanji, Becker, Mudgal, Jupiter, & Ring, 2014](#)).
- i. The clinical diagnosis is confirmed by 1) patient's history of paresthesia in two of the following digits: thumb, index and middle finger; and 2) at least one of the physical exam signs listed below. Provocative tests must recreate symptoms in the median nerve distribution ([Boocock et al., 2009](#)).
- A) Positive Phalen's sign.
- B) Modified Phalen's test: There is some evidence that in patients with suspected carpal tunnel syndrome, a modified Phalen's test can, in comparison with the traditional Phalen's test, increase the sensitivity of the physical examination without sacrificing specificity. The test involves placing the hands of the patient in the usual flexed position for the traditional Phalen's test and applying a 2.83 unit Semmes-Weinstein monofilament perpendicular to the palmar aspect and to the lateral side of the distal phalanx of the digits innervated by the median nerve. Report as positive any test

result in which the patient is unable to detect the application of the filament. The distal phalanx of the fifth digit should be used as a control ([Bilkis et al., 2012](#)).

- C) Positive Tinel's sign over the carpal tunnel.
  - D) Positive closed fist test (holding fist closed for 60 seconds reproducing median nerve paresthesia).
  - E) Positive compression test (applying compression over the median nerve for 30 to 60 seconds reproducing symptoms).
  - F) Compression with wrist flexed at 60°, elbow flexed and forearm supinated ([Chammas, 2014](#)).
  - G) Thenar atrophy may be present, usually late in the course.
  - H) Weakness of the abductor pollicis brevis. Apply resistance at the first metacarpophalangeal joint.
  - I) Sensory loss to pinprick, light touch, two-point discrimination, or Semmes Weinstein monofilament tests in a median nerve distribution. No loss of sensation in the central palm. The middle finger is likely to demonstrate 2 point discrimination or Semmes Weinstein changes that correlate to positive electrodiagnostic tests ([Elfar, Yaseen, Stern, & Kiefhaber, 2010](#)).
  - J) The scratch test is interesting but appears to be less accurate than other tests ([Makanji et al., 2014](#)).
- ii. Physicians should be aware that both NCV-diagnosed carpal tunnel syndrome and physician-diagnosed carpal tunnel syndrome fluctuate over time in both directions for individual cases ([Cherniack et al., 2008](#)).
  - iii. Evaluation of the contralateral wrist is recommended due to the frequency of bilateral involvement.
  - iv. Evaluation of the proximal upper extremity and cervical spine for other conditions is recommended: cervical radiculopathy, thoracic outlet syndrome, other peripheral neuropathies, and other musculoskeletal conditions.
  - v. Assessment for signs of underlying medical disorders associated with carpal tunnel syndrome is recommended (e.g., diabetes mellitus, arthropathy, and hypothyroidism).

- vi. Myofascial findings requiring treatment may present in additional soft tissue areas. These should be identified and treated in accordance with medical treatment guidelines.

e. **Diagnostic Testing Procedures:**

- i. **Diagnostic Steroid Injections:** Classic findings of carpal tunnel syndrome include subjective numbness or dysesthesias confined to the median nerve distribution, worsening of symptoms at night, and positive exam findings. When the diagnosis is in question, steroid injection into the carpal tunnel is a strongly supportive test if it is followed by significant relief of symptoms. A negative diagnostic steroid injection does not eliminate the diagnosis of carpal tunnel syndrome.
- ii. **Electrodiagnostic (EDX) Testing:** Nerve conduction needle electromyography (EMG) and nerve conduction velocity (NCV) are well-established and widely accepted for evaluation of patients suspected of having carpal tunnel syndrome. The results are sensitive and specific for the diagnosis when clinical symptoms are present. Studies may confirm the diagnosis or direct the examiner to alternative conditions. When polyneuropathy is suspected, it may be worthwhile to perform electrodiagnostic testing in the lower extremities. Studies require clinical correlation due to the occurrence of false positive and false negative results. Symptoms of carpal tunnel syndrome may occur with normal EDX studies, especially early in the clinical course.

EDX studies are imperfect indicators of the outcome of treatment of carpal tunnel syndrome, since they may be only weakly correlated with functional scores ([Schrijver et al., 2005](#)). However, they may provide useful information when symptomatic and functional recovery after treatment has not occurred.

EDX findings in carpal tunnel syndrome reflect slowing of median motor and sensory conduction across the carpal tunnel region due to demyelination. Axonal loss, when present, is demonstrated by needle electromyography in median nerve supplied thenar muscles.

- A) Needle electromyography of a sample of muscles innervated by the C5 to T1 spinal roots, including a forearm muscle and/or thenar muscle innervated by the median nerve of the symptomatic limb, is frequently required.

- B) The following EDX studies are **not recommended** to confirm a clinical diagnosis of carpal tunnel syndrome:
- 1) Due to low sensitivity and specificity compared to other EDX studies, multiple median F wave parameters and sympathetic skin response are **not recommended** ([American Association of Neuromuscular & Electrodiagnostic Medicine, 2002](#)).
  - 2) Investigational studies: Evaluation of the effect on median nerve conduction with limb ischemia, dynamic hand exercises, and brief or sustained wrist positioning are **not recommended** ([American Association of Neuromuscular & Electrodiagnostic Medicine, 2002](#)).
  - 3) Electroneurometer: This is **not recommended** as a diagnostic tool because it requires patient participation, cannot distinguish between proximal and distal lesions, and does not have well-validated reference values.
  - 4) Portable Automated Electrodiagnostic Device: measures distal median nerve motor latency and F-wave latency. It remains an investigational instrument whose performance in a primary care setting is not yet established and is **not recommended** as a substitute for conventional electrodiagnostic testing in clinical decision making. Refer to Section E Follow-up Diagnostic Imaging and Testing Procedures for details.
- C) To assure accurate testing, temperature should be maintained at 32 to 34C, preferably recorded from the hand/digits. For temperature below 32C, the hand should be warmed ([Sandin, Asch, Jablecki, Kilmer, & Nuckols, 2010](#)).
- D) Positive Findings: Any of these nerve conduction study findings must be accompanied by median nerve symptoms to establish the diagnosis:
- 1) Slowing of median distal sensory and/or motor conduction through the carpal tunnel region.

- 2) Electromyographic changes in the median thenar muscles in the absence of proximal abnormalities.
- 3) Suggested guidelines for the upper limits of normal latencies ([Sandin et al., 2010](#); [Werner & Andary, 2011](#)):
  - a) Median distal motor latency (DML): 4.5 ms / 8 cm.
  - b) Median distal sensory peak latency (DSL): 3.6 ms / 14 cm.
  - c) Median intrapalmar peak latency (palm/wrist): 2.2 ms / 8 cm.
  - d) Median-ulnar palmar sensory latency difference: 0.4 ms at 8 cm.
  - e) Median Comparison with radial nerve sensory/mixed latency: 0.4 ms at 10 cm.
  - f) Some examiners suggest comparing the sensory latencies for index and ring finger both the half distance and full distance to confirm the diagnosis.
  - g) Other comparisons may also be used.
- 4) Because laboratories establish their own norms, a degree of variability from the suggested guideline values (as described in 3 above) is acceptable.

E) Normative values may be provided with the neuro-diagnostic evaluation.

F) Suggested grading scheme by electrodiagnostic criteria for writing a consultation or report may be:

- 1) Mild carpal tunnel syndrome: prolonged (relative or absolute) median sensory or mixed action potential distal latency (orthodromic, antidromic, or palmar).

- 2) Moderate carpal tunnel syndrome: abnormal median sensory latencies as above and prolongation (relative or absolute) of median motor distal latency.
  - 3) Severe carpal tunnel syndrome: prolonged median motor and sensory distal latencies, with either absent sensory or palmar potential, or low amplitude or absent thenar motor action potential. Needle examination reveals evidence of acute or chronic denervation with axonal loss.
- G) Frequency of Studies/Maximum Number of Studies:
- 1) Indications for Initial Testing:
    - a) Patients with clinically significant carpal tunnel syndrome who do not improve symptomatically or functionally with conservative measures for carpal tunnel syndrome over a 3 to 4 week period.
    - b) Patients for whom the diagnosis is in question.
    - c) Patients for whom surgery is contemplated.
    - d) To rule out other nerve entrapments or alternative radiculopathy.
  - 2) Repeated studies may be performed, preferably by the previous electrodiagnostician:
    - a) At 8 to 12 weeks for inadequate improvement with non-surgical treatment.
    - b) At 12 weeks or longer when the initial studies were normal and carpal tunnel syndrome is still suspected.
    - c) Post-operative 3 to 6 months for persistent or recurrent symptoms following carpal tunnel release, unless an earlier evaluation is required by the surgeon.

- iii. **Laboratory Tests:** In one study of carpal tunnel patients seen by specialists, 9% of patients were diagnosed with diabetes, 7% with hypothyroidism, and 15% with chronic inflammatory disease including spondyloarthropathy, arthritis, and systemic lupus erythematosus. Up to two thirds of the patients were not aware of their concurrent disease ([Atcheson et al., 1998](#)). Estimates of the prevalence of hypothyroidism in the general population vary widely, but data collected from the Colorado Thyroid Disease Prevalence Study revealed subclinical hypothyroidism in 8.5% of participants not taking thyroid medication. The prevalence of chronic joint symptoms in the Behavioral Risk Factor Surveillance System (BRFSS) from the Centers for Disease Control (CDC) was 12.3%. If initial history suggests concomitant disease or after 2 to 3 weeks the patient is not improving, the physician should strongly consider the following laboratory studies: thyroid function studies, rheumatoid screens, chemical panels, and others if clinically indicated. In one study, 14% of carpal tunnel syndrome patients were diagnosed with new onset diabetes ([Plastino et al., 2011](#)). There is some evidence that diabetic patients with upper extremity disorders are more likely to be under poor diabetic control ([Ramchurn et al., 2009](#)). Therefore, it is appropriate to order a hemoglobin A1c for any diabetic patients with a carpal tunnel syndrome or other laboratory tests to detect diabetes ([Ramchurn et al., 2009](#)).

Laboratory testing for cumulative trauma conditions may be required periodically to monitor patients on chronic medications.

- iv. **Other Tests:**
- A) Imaging, MRI, and sonography are **not recommended** unless a space occupying lesion is suspected.
  - B) Electroneurometer and other portable automated electro-diagnostic devices are **not recommended**. Refer to Section E Follow-up Diagnostic Imaging and Testing Procedures.
  - C) Ultrasound has been shown to be useful. However, it has not surpassed the need for EMG to determine the need for surgery ([Sucher & Schreiber, 2014](#)).

f. **Non-operative Treatment Procedures:**

- i. **Initial Treatment:** medications such as analgesics and over the counter medications for symptomatic relief, wrist splint at night, and

restriction of activities based on a job site ergonomic evaluation when indicated.

There is strong evidence that, in patients with carpal tunnel syndrome which has not become chronic, carpal tunnel release leads to a moderate treatment advantage with respect to functional improvement 6 months after surgery. While there is considerable benefit from conservative treatment such as splinting and individualized hand therapy, there is insufficient evidence to identify which patients are likely not to benefit from conservative treatment sufficiently to avoid surgery ([Shi & MacDermid, 2011](#)).

- ii. Patient education: should include instruction in self-management techniques, including sleeping postures which avoid excessive wrist flexion; ergonomics; and a home therapy program. Episodes of recurrence are common, so patient education regarding provocative activities is essential for long term recovery.
- iii. Job site evaluations and alterations: Ergonomic alterations should be done early to assure that appropriate changes are accomplished early in the treatment program. In a 2007 published study, it was noted that 73% of mild cases referred for carpal tunnel surgery received splints, 23% steroid injections and only 15% modification in activities recommendations. This emphasizes the need for basic initial care including job site modification for all patients, especially in milder cases that may not require surgery ([Burke, Bradley, Sinha, Wilgis, & Dubin, 2007](#)).

There is insufficient evidence to support ergonomic positioning or keyboards as clearly beneficial for carpal tunnel syndrome ([B. M. Huisstede, Hoogvliet, et al., 2010](#); [O'Connor, Page, Marshall, & Massy-Westropp, 2012](#)).

One study of a variety of vertical and gel mouse pads did not support the use of any particular pad to decrease carpal tunnel pressure ([Schmid, Kubler, Johnston, & Coppieters, 2015](#)).

Whenever a case is identified as a work related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite.



Ergonomic job site evaluation and change are a required treatment for all cumulative trauma conditions as this may eliminate the need for invasive treatment.

Suggested ergonomic changes usually also apply to uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and Section H.6 Job Site Alteration.

- iv. Medications and Medical Treatment: Use of medications in the treatment of carpal tunnel syndrome is appropriate for controlling acute and chronic pain and inflammation. All drugs should be used according to patient needs. A thorough medication history, including use of alternative and over the counter medications, should be performed at the time of the initial visit and updated periodically.

There is good evidence that NSAIDs and diuretics add no benefits for symptom improvement compared to placebo at 4 weeks, and some evidence that Vitamin B6 adds no benefit on symptom improvement compared to placebo at 10-12 weeks ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). The American Academy of Orthopaedic Surgeons (AAOS) says there is moderate evidence against non-steroid oral medications. Although NSAIDs are not curative, they and other analgesics may provide symptomatic relief.

Oral Steroids: There is good evidence that oral steroids are more effective than placebo in improving symptoms in the short term, and there is some evidence that they are not effective in the long term (12 months) ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is some evidence that 6 weeks of oral steroids are more effective than splinting in improving function but not symptoms in the short term. Given the lack of long term effects and the problematic side effects, steroids are **not recommended**.

- v. Orthotics/Immobilization with Splinting: Splints should be loose and soft enough to maintain comfort while supporting the wrist in a relatively neutral position. This can be accomplished using a soft or rigid splint with a metal or plastic support. Some splints include immobilization of the metacarpophalangeal joints. Splint comfort is critical and may affect compliance. Although off-the-shelf splints are usually sufficient, custom thermoplastic splints may provide a better fit for certain patients.

There is no evidence in favor of full-time use of a wrist splint compared with night-only use ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is no evidence in favor of a wrist splint in the neutral

position compared to an extended wrist position of 20° in the short term (2 weeks) ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is insufficient evidence to support a specific type of splint for splinting over other treatment ([B. M. Huisstede, Hoogvliet, et al., 2010](#)).

There is some evidence in the short term (4 weeks) and absence of evidence in the midterm (4-6 months) that a nocturnal hand brace is more effective for reducing pain and improving function compared to no treatment ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is some evidence in the short term that a 3-month night treatment with either the soft hand brace or the wrist splint is effective in reducing symptoms and improving function, but there is no significant difference between the 2 interventions ([B. M. Huisstede, Hoogvliet, et al., 2010](#)).

Splints may be effective when worn at night or during portions of the day, depending on activities. Depending on job activities, intermittent daytime splinting can also be helpful. Splint use is rarely mandatory. Providers should be aware that over-usage is counterproductive and should counsel patients to minimize daytime splint use in order avoid detrimental effects such as stiffness and dependency over time.

- ❖ Time to Produce Effect: 2 to 4 weeks. If after 4 weeks, the patient has partial improvement, continue to follow since neuropathy may worsen, even in the face of diminished symptoms.

- vi. Steroid injections: may be considered for management of mild to moderate carpal tunnel symptoms after conservative therapies have failed. There is good evidence that steroid injections have better results at 3 months than oral steroids ([Wong et al., 2001](#)). There is good evidence that a steroid injection produces a significant decrease in carpal tunnel symptoms for up to 10 weeks, with outcomes comparable to surgery ([Atroshi, Flondell, Hofer, & Ranstam, 2013](#)). Another study showed some evidence of significant improvement in symptom scores at 6 weeks in both injection and surgery. However, by 20 weeks, there was a diminishing of the response to injection while the surgery group had a persistent improvement in symptoms. It should be noted that while the symptoms worsened over time in the injection group, there was still an increase in grip strength at 4 months of 2.4kg whereas the surgery group had a decrease of 1.7kg ([Hui et al., 2005](#)). There is also good evidence showing that improvement in symptoms after steroid injection begins to decrease over time and by 1 year, 73-81% of those patients receiving steroids require surgical

intervention due to relapsing symptoms ([Atroshi et al., 2013](#)). An additional study demonstrated some evidence that only 51% percent of patients with mild to moderate carpal tunnel symptoms responded to steroid injections with a significant response, and of those that responded, 49% required additional injections and/or surgery by 1 year ([Peters-Veluthamaningal, Winters, Groenier, & Meyboom-de Jong, 2010](#)).

There is good evidence that in patients with carpal tunnel syndrome who have not improved after 2 months of splinting, an injection of 80 mg of methylprednisolone and of 40 mg of methylprednisolone are equally likely to lead to short-term 5-week improvements in carpal tunnel symptoms compared to placebo. However, the success of methylprednisolone in avoiding surgery in carpal tunnel syndrome patients is modest. Although approximately 92% of placebo-injected patients are likely to require carpal tunnel release within one year, about three quarters of patients who have a methylprednisolone injection are also likely to have surgery. However, this modest difference in rates of surgery may prevent a large number of carpal tunnel release operations if steroid injections are offered to a large population of carpal tunnel syndrome patients who continue to have symptoms after a 2 month trial of splinting ([Atroshi et al., 2013](#)).

There is some evidence that 60mg methylprednisone injection is more effective than 20 or 40mg methylprednisone at 6 months but not at one year ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is some evidence that there is no significant difference between a single corticosteroid injection of 15mg methylprednisolone compared with 2 local corticosteroid injections regarding symptom improvement at 8, 24, and 40 weeks after injection ([B. M. Huisstede, Hoogvliet, et al., 2010](#)).

When approaching the decision to consider steroid injection in a patient with mild to moderate carpal tunnel syndrome, it is important to consider the trend of a good initial therapeutic response followed by a diminishing response after 3 months and high rates of relapse by 1 year. Underlying medical conditions and potential ergonomic risk factors for carpal tunnel syndrome should be considered and addressed, if possible. In the case of an identified modifiable condition, a steroid injection may provide a less invasive short-term response to manage symptoms. Shared decision making with the patient should be had regarding the high risk of relapse and the potential lack of response after steroid injection. If a steroid injection is performed and symptoms recur following the first injection

symptomatic relief, the decision to perform a second injection must be weighed against alternative treatments such as surgery.

Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections. Refer to Section H.4.c Steroid Injections for further details.

- ❖ Time to Produce Effect: 1 to 2 injections. If the first injection is unsuccessful and symptoms continue, the second injection should be performed by a specialist with expertise in the anatomy of the upper extremity.

- ❖ Maximum Frequency: 3 injections.

- vii. Nerve Gliding: Exercises consist of ROM of the upper extremity and neck that produce tension and longitudinal movement along the length of the median and other nerves of the upper extremity.

These exercises are based on the principle that the tissues of the peripheral nervous system are designed for movement and that tension and glide (excursion) of nerves may have an effect on neurophysiology through alterations in vascular and axoplasmic flow. The exercises are simple to perform and can be done by the patient after brief instruction. Biomechanical principles have been more thoroughly studied than clinical outcomes.

There is no evidence in favor of the addition of tendon and nerve gliding exercises to 4 weeks of night splinting compared to splinting alone ([B. M. Huisstede, Hoogvliet, et al., 2010](#)).

There is good evidence that neuro-dynamic technique plus splinting add no benefit to reduce pain or improve function compared to splinting alone after 3 weeks ([B. M. Huisstede, Hoogvliet, et al., 2010](#)).

Due to lack of quality evidence, use of mobilization and exercise should be based on patient preference and provider expertise ([Page, O'Connor, Pitt, & Massy-Westropp, 2012](#)).

- ❖ Time to Produce Effect: 2 to 4 weeks.

- ❖ Frequency: Up to 5 times per day by patient (patient-initiated).

- ❖ Optimum Duration: 2 provider-directed sessions.
- ❖ Maximum Duration: 3 provider-directed sessions.

viii. Manual Therapy Techniques: There is good evidence that manual and manipulative therapy combined with exercise and/or multimodal therapy shows small, clinically important reductions in pain and improved physical function in the short-term care ( $\leq 3-6$  months) of patients with lateral epicondylitis and carpal tunnel syndrome ([Brantingham et al., 2013](#)).

There is some evidence from a high quality randomized controlled trial that an initial treatment approach for carpal tunnel syndrome involving physical manual therapy directed at the entire course of the median nerve from the scalene muscles to the wrist, in combination with nerve and tendon gliding exercises, is as successful as carpal tunnel release at 6 months and at 1 year. The physical manual therapy combined with nerve and tendon gliding exercises may show advantages over surgery at 1 and 3 months. However, there was incomplete analysis of patient data ([Fernandez-de-Las Penas et al., 2015](#)).

There is good evidence that soft tissue mobilization plus home exercises is effective in reducing pain and improving function at 6 months ([B. M. Huisstede, Randsdorp, et al., 2010](#)).

Use of mobilization and exercise should be based on patient preference and provider expertise ([Cochrane] [Page et al., 2012](#)).

- ❖ Time to Produce Effect: 4 to 6 weeks.
- ❖ Frequency: 1 to 3 times per week.
- ❖ Optimum Duration: 4 to 6 weeks.
- ❖ Maximum Duration: 8 weeks.

ix. Ultrasound: There is some evidence that ultrasound is no more effective than placebo at 2 weeks of follow-up regarding pain, symptoms, and function. However, there is some evidence that ultrasound is more effective in improving symptoms only, not function, compared to placebo at 7 weeks of follow-up and in the midterm (4-6 months) ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is some evidence that there is no significant difference between an ultrasound intensity of  $1.5W/cm^2$  compared with  $0.8W/cm^2$  regarding pain and

symptom improvement after 2 weeks ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is some evidence that ultrasound is more effective on pain and function than low level laser therapy at 4 weeks; however, low level laser is ineffective ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is some evidence that there is no beneficial effectiveness of pulsed or continuous ultrasound combined with splint therapy compared to sham ultrasound and splint therapy in reducing pain and symptoms and improving functionality for treating patients with mild or moderate idiopathic carpal tunnel syndrome. This study is inconclusive in its ability to find an effect due to only 70% power and a small sample size ([Armagan, Bakilan, Ozgen, Mehmetoglu, & Oner, 2014](#)).

Another systematic review found insufficient evidence to support ultrasound therapy ([Page, O'Connor, Pitt, & Massy-Westropp, 2013](#)).

There is some evidence that ultrasound therapy plus splinting is no more effective than placebo ultrasound plus splinting in reducing pain and symptoms and improving functionality in the conservative treatment of patients with carpal tunnel syndrome ([Yildiz et al., 2011](#)).

Therefore, ultrasound without phonophoresis is **not recommended**.

- x. Low Level Laser Therapy (LLLT): There is some evidence that LLLT adds no short term benefit for reducing symptoms and improving function compared to full-time splinting for 3 months ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is good evidence that laser therapy is ineffective regarding pain and function compared with placebo as an intervention to treat carpal tunnel syndrome in the short term ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is some evidence that LLLT is no more effective than placebo LLLT in reducing pain and symptoms and improving functionality in the conservative treatment of patients affected by carpal tunnel syndrome ([Tascioglu, Degirmenci, Ozkan, & Mehmetoglu, 2012](#)). There is some evidence that LLLT plus splinting is no more effective than splinting alone in reducing carpal tunnel symptoms and improving functionality in the conservative treatment of patients affected by carpal tunnel syndrome ([Yagci et al., 2009](#)). There is good evidence from a number of adequate studies that LLLT does not add benefit and it **is not recommended**.
- xi. Yoga: There is some evidence that yoga is equally as effective in reducing pain and improving grip strength as wrist splinting in the short term ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is some evidence that Hatha yoga instruction may reduce pain and improve grip strength as effectively as splinting. However, the evidence was

inadequate to show superiority over splinting ([Garfinkel et al., 1998](#)). This, as is the case with other complementary/alternative exercise, should be done with oversight of a physician or other appropriate healthcare professional for motivated patients preferring this treatment.

- ❖ Time to Produce Effect: 2 to 6 treatments.
- ❖ Frequency: 2 times per week.
- ❖ Optimum and Maximum Duration: 4 to 8 weeks.

xii. Iontophoresis: may be an appropriate option for patients refusing or wishing to delay surgery and injections. There is no evidence in favor of dexamethasone iontophoresis on symptom improvement compared to a placebo control group at 3 and 6 months ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). Under current FDA regulations, the physician will issue a prescription to the patient for the dexamethasone for this treatment and the patient will usually need to transport the medication to the treatment location.

- ❖ Optimum and Maximum Frequency: 6 to 9 sessions over 5 weeks.

xiii. Acupuncture and Magnets: There is no evidence for the use of magnets, laser acupuncture, or chiropractic treatment. Therefore, these interventions are **not recommended** ([O'Connor, Marshall, & Massy-Westropp, 2003](#)).

There is some evidence that laser acupuncture adds no benefits to night pain improvement compared to placebo at 3 weeks ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is some evidence that there are no differences between needle acupuncture combined with a wrist brace and placebo needle acupuncture combined with a wrist brace. Neither treatment is clinically effective in improving function in patients with mild or moderate carpal tunnel syndrome ([E. Yao et al., 2012](#)). Therefore, it is **not recommended**.

xiv. There is no evidence in favor of massage therapy, heat wrap therapy, and cupping therapy for the treatment of carpal tunnel syndrome in the short term ([B. M. Huisstede, Hoogvliet, et al., 2010](#)).

xv. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work.

- xvi. Other therapies in Section H Therapeutic Procedures – Non-Operative may be used for myofascial symptoms accompanying carpal tunnel syndrome.

- g. **Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.

There is strong evidence that in patients with carpal tunnel syndrome which has not become chronic, carpal tunnel release leads to a moderate treatment advantage with respect to functional improvement 6 months after surgery. However, there is considerable benefit to conservative treatment such as worksite ergonomic changes, splinting, and individualized hand therapy, which are appropriate for first-line treatment. There is insufficient evidence to identify which patients are likely not to benefit from conservative treatment sufficiently to avoid surgery ([Shi, MacDermid, Santaguida, & Kyu, 2011](#)).

For patients with clinically typical carpal tunnel symptoms of median nerve distribution numbness, with or without pain, which awakens the patient at night and is alleviated by shaking the hand: there is some evidence that the symptom and function outcomes of mini-open carpal tunnel release are similar at 6 months for patients who do and do not undergo preoperative nerve conduction studies. However, the study excluded patients with atypical symptoms or unusual courses of disease, recurrent syndrome, diabetic neuropathy, and cervical radiculopathy ([Zyluk & Szlosser, 2013](#)).

Overall, it is probably reasonable to expect that 40 to 50% of patients with mild exam findings may improve or remain stable overtime ([Kaplan, Glickel, & Eaton, 1990](#); [Ortiz-Corredor, Enriquez, Diaz-Ruiz, & Calambas, 2008](#); [Padua et al., 2001](#)).

There is strong evidence that surgery is more effective than splinting or injections in producing long-term symptom relief and normalization of median nerve conduction velocity for those patients with clinically significant carpal tunnel syndrome with positive nerve conduction velocity findings ([Gerritsen et al., 2002](#); [Hui et al., 2005](#); [Jarvik et al., 2009](#)). There is also a positive cost utility for surgery over conservative care for patients with positive nerve conduction studies ([Pomerance, Zurakowski, & Fine, 2009](#)). There is good evidence that surgery improves symptoms more effectively than steroid injection for up to five months ([Hui et al., 2005](#)).

In one prospective study, duration of symptoms prior to surgery, up to 5 years, did not affect the ability to achieve symptom or functional outcome success with surgery. Patients with more severe symptoms and longer duration of



symptoms showed significant improvement with surgery ([Capasso, Manzoli, & Uncini, 2009](#)). Patients with thenar atrophy, weakness of the abductor pollicis brevis, and fixed sensory deficits may still improve with surgery. Patients with mild symptoms and functional deficits demonstrated the smallest changes from pre- to post-operative scores. However, their post-operative scores were higher than the post-operative scores of those with more severe symptoms ([Burke, Wilgis, Dubin, Bradley, & Sinha, 2006](#)).

- i. Surgery should be considered as an initial therapy in situations where clinical evidence of carpal tunnel syndrome is present based on the criteria below.
  - A) Median nerve trauma has occurred; “acute carpal tunnel syndrome;” or
  - B) Thenar atrophy is present and due to median nerve compression; or
  - C) Electrodiagnostic evidence of moderate to severe entrapment or compression neuropathy is present. EMG findings showing evidence of acute or chronic motor denervation suggest the possibility that irreversible damage may be occurring. There is good evidence that surgery is more beneficial than non-surgical treatment for patients with a motor latency of more than 4.5 ms ([Hui et al., 2005](#); [Jarvik et al., 2009](#)).
- ii. For cases with positive EDX findings, non-surgical treatment may be beneficial in some cases. Therefore, conservative management, including job alterations, should be tried over 4 to 6 weeks before surgery is considered ([Jarvik et al., 2009](#)). One prospective cohort study notes that negative electrodiagnostic testing decreases the likelihood of surgery by 11% ([Becker, Makanji, & Ring, 2014](#)). At least one study suggests that patients with more severe symptoms who fail one course of conservative therapy should progress to surgery ([N. A. Baker & Livengood, 2014](#)).
- iii. Surgery may be considered in cases where electrodiagnostic testing is normal and initial non-operative therapy has failed. A second opinion from a hand surgeon is strongly recommended. The following criteria should be considered in deciding whether to proceed with surgery:
  - A) The patient's signs and symptoms are specific for carpal tunnel syndrome;

AND

- B) The patient experiences significant temporary relief of at least 80% improvement on a Visual Analog Scale following steroid injection into the carpal tunnel.
- iv. Prior to surgical intervention, the patient and the treating physician should identify functional operative goals, the likelihood of achieving improved ability to perform activities of daily living or work, and possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.
- v. Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since patients with the most common conditions will improve significantly over time, without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.
- vi. Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

**h. Operative Procedures:**

- i. Open and endoscopic carpal tunnel release techniques: There is some evidence that, in patients with carpal tunnel syndrome requiring surgery, endoscopic carpal tunnel release (ECTR) leads to earlier recovery of grip strength and earlier return to work than open carpal tunnel release (OCTR) ([Cochrane] ([Vasiliadis, Georgoulas, Shrier, Salanti, & Scholten, 2014](#))). There is good evidence that ECTR and

OCTR are nearly equivalent with respect to short-term and long-term pain, numbness, and patient-reported general hand function ([Atroshi et al., 2009](#); [Atroshi, Hofer, Larsson, & Ranstam, 2015](#)). Choice of technique should be left to the discretion of the surgeon.

- ii. **Complications:** Endoscopic and open carpal tunnel release have low rates of serious complications, reportedly up to 0.5% ([Abrams, 2009](#); [Chammas, 2014](#)). However, some studies have reported higher rates of complex regional pain syndrome after surgery unrelated to the anesthetic technique ([da Costa, de Oliveira, Fernandes Mdo, & Saraiva, 2011](#)). The most commonly seen serious complications are incomplete transection of the transverse carpal ligament and inadvertent nerve or vessel injuries. Serious complications are rare and include permanent nerve damage and infection. Pillar pain may persist for 20 months; a burning sensation and scar tenderness are also common in up to 18% of cases ([Boya, Ozcan, & Oztekin, 2008](#)). Reoccurrence is possible, although reoperation usually occurs in less than 5% of the population ([Amadio, 2009](#)).
- iii. There is some evidence that, in patients undergoing endoscopic carpal tunnel release, local anesthesia controls intraoperative pain as effectively as intravenous regional anesthesia, and local anesthesia may be simpler and less invasive to perform, with shorter tourniquet inflation and operating room times than intravenous regional anesthesia ([Nabhan, Steudel, Dedeman, Al-Khayat, & Ishak, 2011](#)).
- iv. **Neurolysis:** has not been proven advantageous for carpal tunnel syndrome. Internal neurolysis should never be done.
- v. **Tenosynovectomy:** For routine cases of carpal tunnel syndrome, tenosynovectomy has not proven to be beneficial. Although achy pain in the wrist and forearm commonly may accompany carpal tunnel syndrome, paresthesias tends to be the predominant complaint. In occasional cases, pain may be the predominant complaint. If a patient with documented carpal tunnel syndrome experiences pain along the volar wrist, hand, and/or distal forearm as the predominant symptom, clearly overshadowing the paresthesias, there may be a significant component of tenosynovitis. Tenosynovectomy should be considered in these unusual cases at the time of carpal tunnel release.

**i. Post-operative Treatment:**

- i. Patients should receive a home therapy protocol involving stretching, ROM, scar management, and resistive exercises. Patients should be

encouraged to use the hand as much as possible for daily activities, allowing pain to guide their activities.

- ii. There is some evidence that immediate mobilization of the wrist following surgery is associated with less scar pain and faster return to work ([Cook, Szabo, Birkholz, & King, 1995](#)). There is some evidence that removal of a bulky dressing after mini-open Carpal Tunnel Release and replacement with an adhesive strip at 48 to 72 hours causes no wound complications and results in equal short-term (2-week) clinical and subjective outcome measures compared with using a bulky dressing for 2 weeks ([Ritting et al., 2012](#)). Final decisions regarding the need for splinting post-operatively should be left to the discretion of the treating physician based upon the surgical technique used and the specific conditions of the patient.
- iii. An individualized rehabilitation program may be helpful in patients who do not show functional improvements post-operatively or in patients with heavy or repetitive job activities. There is good evidence that routine use of hand therapy after surgery does not improve pain, function, or return to work in carpal tunnel syndrome uncomplicated by endocrine disease, arthritis, or advanced median nerve disease ([Pomerance & Fine, 2007](#)). However, workers' compensation patients may have slower return to work and therefore at least 2 visits with the therapist are recommended to insure appropriate scar management and return to function.

There is insufficient evidence to formulate a post-operative care plan ([Cochrane] ([Peters, Page, Coppieters, Ross, & Johnston, 2013](#)).

The rehabilitation program should be based upon communication between the surgeon and the therapist and using therapies as outlined in Section H Therapeutic Procedures – Non-Operative. In all cases, communication between the physician and therapist is important to the timing of exercise progressions.

- iv. Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon.

**Suggested parameters for return-to-work are:**

Time Frame	Activity Level
2 days	Return to work with restrictions on utilizing the affected extremity

2 to 3 weeks	Sedentary and non-repetitive work
4 to 6 weeks	Case-by-case basis
6 to 12 weeks	Heavy labor, forceful and repetitive

Note: All return-to-work decisions are based upon clinical outcome ([Cowan, Makanji, Mudgal, Jupiter, & Ring, 2012](#)).

- v. Considerations for repeat surgery: The single most important factor in predicting symptomatic improvement following carpal tunnel release is the severity of preoperative neuropathy. Patients with moderate electrodiagnostic abnormalities have better results than those with either very severe and/or mild findings ([Burke et al., 2006](#)). Incomplete cutting of the transverse carpal ligament or iatrogenic injury to the median nerve are rare.

Relief from steroid injections may provide additional confirmation ([Beck et al., 2012](#)). If median nerve symptoms do not improve following initial surgery or the symptoms improve initially and then recur but are unresponsive to non-operative therapy (Section H Therapeutic Procedures – Non-Operative), consider the following:

- A) Recurrent synovitis;
- B) Repetitive work activities may be causing “dynamic” carpal tunnel syndrome;
- C) Scarring;
- D) Work-up for systemic diseases.

A second opinion by a hand surgeon and repeat nerve conduction studies are required if repeat surgery is contemplated. The decision to undertake repeat surgery must factor in all of the above possibilities. Results of surgery for recurrent carpal tunnel syndrome vary widely depending on the etiology of recurrent symptoms.

## 2. **CUBITAL TUNNEL SYNDROME**

- a. **Description/Definition:** The following are typical symptoms of cubital tunnel syndrome:
- i. Activity related pain/paresthesias involving the 4th and 5th fingers coupled with discomfort near the medial aspect of the elbow;
  - ii. Pain/paresthesias worse at night;
  - iii. Decreased sensation of the 5th finger and ulnar half of the ring finger (including dorsum 5th finger);
  - iv. Progressive inability to separate fingers;
  - v. Loss of power grip and dexterity.
- b. **Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections.
- c. **Specific Physical Exam Findings:** Required elements for the diagnosis include paresthesias or dull ache in the 4th and 5th digits and at least one of the following exam findings:
- i. Diminished sensation of the fifth and ulnar half of the ring fingers, which may sometimes include sensory loss to pinprick, light touch, two-point discrimination or Semmes Weinstein monofilament tests in an ulnar nerve distribution;
  - ii. Positive elbow flexion/ulnar compression test. The combination flexion pressure test can be performed by fully flexing the elbow in supination and applying pressure to the ulnar nerve proximal to the cubital tunnel for 60 seconds. Reproduction of symptoms is a positive test ([Novak, Lee, Mackinnon, & Lay, 1994](#));
  - iii. Testing elbow maximum flexion at 1 and 3 minutes also appears to have reasonable sensitivity and specificity ([Hutchison & Rayan, 2011](#));
  - iv. Later stages manifested by intrinsic atrophy or weakness and ulnar innervated intrinsic weakness. Specific physical signs include clawing of the ulnar 2 digits, ulnar drift of the 5th finger (Wartenberg's sign), or flexion at the thumb interphalangeal (IP) joint during pinch (Froment's sign).

**d. Diagnostic Testing Procedures:**

MRI: Imaging is generally not indicated but may be useful when space occupying lesions are suspected ([Assmus et al., 2011](#)).

EDX: Electrodiagnostic (EDX) studies are well-established and widely accepted for evaluation of patients suspected of having peripheral nerve pathology. Studies may confirm the diagnosis or direct the examiner to alternative disorders. When polyneuropathy is suspected, it may be worthwhile to perform electrodiagnostic testing in the lower extremities. Studies require clinical correlation due to the occurrence of false positive and false negative results. Symptoms of peripheral nerve pathology may occur with normal EDX studies, especially early in the clinical course.

To assure accurate testing, temperature should be maintained at 32 to 34 degrees C, preferably recorded from the hand/digits. For temperature below 32 degrees C, the hand should be warmed.

All studies must include normative values for their laboratories. Studies of both upper extremities may be done for comparison.

During the study, the elbow should be maintained in moderate flexion, usually 70-90 degrees. Two positive findings in this position constitute a positive test. The following criteria are used:

- i. Absolute motor nerve conduction velocity from above elbow to below elbow less than 50 ms.
- ii. Above to below elbow segment more than 10 ms slower than the below elbow to wrist segment.
- iii. Decrease in compound muscle action potential (CMAP) negative peak amplitude from below the elbow to above the elbow of 20%.
- iv. Significant change in CMAP configuration at the above elbow site compared to below elbow.
- v. Desynchronization of the motor action potential after stimulation proximal, but not distal, to the ulnar groove.
- vi. Focal slowing on inching studies across the elbow; latency exceeding 0.7 milliseconds across 2 inches ([Carter, Weiss, Friedman, Allan, & Robinson, 2015](#)).
- vii. Indications for testing:

- A) Initial testing:
- 1) Patients with clinically significant cubital tunnel findings who do not improve symptomatically or functionally with conservative measures, including job site alteration over a 3 to 4 week period.
  - 2) Patients for whom the diagnosis is in question.
  - 3) Patients for whom surgery is contemplated.
  - 4) To rule out other nerve entrapments, or alternative radiculopathy, including C8 or brachial plexopathy.
- B) Other studies may be performed:
- 1) At 3 months or longer when the initial studies were normal and cubital tunnel syndrome is still suspected.
  - 2) At 8 to 12 weeks for inadequate improvement with non-surgical treatment.
  - 3) Post-operative 3 to 6 months for persistent or recurrent symptoms following ulnar nerve surgery, unless an earlier evaluation is required by the surgeon.

e. **Non-operative Treatment Procedures:**

- i. Initial Treatment: Medications such as analgesics and over the counter medications for symptomatic relief; elbow pad anteriorly at 30 to 60 degrees or towel around elbow at night, optional posterior pad for daywear, and restriction of activities ([Darowish, Lawton, & Evans, 2009](#)).
- ii. Patient education: should include instruction in self-management techniques including avoidance of excessive or repetitive elbow flexion, ergonomics, and a home therapy program. There is some evidence that a trial of conservative treatment for cubital tunnel syndrome is as effective as a treatment program involving nocturnal bracing and a program involving gliding exercises ([Svernlov, Larsson, Rehn, & Adolfsson, 2009](#)). However, this conservative treatment should educate the patient on nerve anatomy, causes of symptoms, and appropriate elbow movements. Recurrence is common, so patient



education regarding provocative activities is essential for long term recovery.

- iii. Job site evaluations and alterations: Ergonomic alterations should be done early to assure the appropriate changes are accomplished early in the treatment program. It is important to avoid activities that apply mechanical pressure to the elbow or cause repetitive flexion ([Assmus et al., 2011](#)).
- iv. Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite. Workers should avoid repetitive full flexion or extension or posterior pressure on the elbow. Employers should consider applying the ergonomic changes to uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and Section H.6 Job Site Alteration.
- v. Steroid injections are **not recommended** due to the lack of evidence and difficulty entering the correct area without causing damage.
- vi. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work.
- vii. Other therapies in Section H Therapeutic Procedures – Non-Operative may be employed in individual cases.

- f. Surgical Indications/Considerations: Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.

Surgery may be considered when 1) findings on history and objective evidence correlate specifically with the diagnosis; 2) job site alteration and other conservative measures have not alleviated the symptoms; and 3) functional deficits persist after 6 to 8 weeks.

Subjective complaints should be localized and appropriate to the diagnosis, neurologic complaints should be consistent with the nerve distribution in question, and physical exam findings should correlate with the history. Objective evidence should be present and include: positive physical exam findings as described in Section G.2.c or a motor deficit commensurate with

the suspected neurologic lesion. In general, patients with minimal symptoms or without objective findings of weakness tend to respond better to conservative treatment.

Surgery may be considered as an initial therapy in situations where there is clinical and electrodiagnostic evidence of severe or progressive neuropathy.

Prior to surgical intervention, the patient and treating physician should identify functional operative goals, the likelihood of achieving improved ability to perform activities of daily living or work, and possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.

Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time, without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.

Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

A second opinion by a hand surgeon and repeat nerve conduction studies are required if repeat surgery is contemplated.

- g. Operative Procedures:** simple decompression or transposition with or without, medial epicondylectomy, anterior subcutaneous transfer, and submuscular or intramuscular transfer. There is good evidence that simple decompression and anterior transposition lead to equally good functional outcomes. There is good evidence that the complication rate in terms of post-operative infection is considerably higher with anterior transposition than with simple decompression, for which the infection rate is approximately two thirds lower ([Cochrane] ([Caliandro, La Torre, Padua, Giannini, & Padua, 2012](#))). Transposition is a more complicated procedure requiring greater operative experience ([Assmus, Antoniadis, & Bischoff, 2015](#)). Simple decompression appears to be cost effective and may be a preferable procedure ([Carter et al., 2015](#); [Song, Chung, & Prosser, 2012](#)).

Simple decompression appears to be effective even in patients with more severe disease ([Biggs & Curtis, 2006](#)), and it has fewer complications. There may be a subset of patients not yet identified by the current literature who would benefit more from a transposition ([Macadam, Gandhi, Bezuhly, & Lefavre, 2008](#)). The complications and complexity of these procedures varies. Patients should understand the risks of each procedure, expected recovery, and need for follow-up therapy before consenting to the procedure.

- h. Post-operative Treatment:** an individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-Operative. In all cases, communication between the physician and therapist is important to the timing of exercise progressions. Treatment may include the following: splinting, scar management, nerve gliding, and active therapy with or without passive therapy. Early active motion is appropriate for most patients. Work restrictions vary based on the procedure from approximately 2 – 6 weeks ([Assmus et al., 2015](#)).

Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon.

### 3. **GUYON CANAL (TUNNEL) SYNDROME**

- a. **Description/Definition:** Typical symptoms/findings are (1) paresthesias in the ulnar nerve distribution (ring and small fingers) distal to the wrist, and/or (2) weakness in digital adductors, abductors or lumbricals, without proximal ulnar complaints.
- b. **Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections. Occupational and non-occupational causes frequently result from mechanical pressure on the wrist or palm, e.g., cycling, vibratory tools.
- c. **Specific Physical Exam Findings:** Required elements for the diagnosis must include at least one of the following exam findings ([Boocock et al., 2009](#)):
- i. Positive Tinel's at hook of hamate.
  - ii. Numbness or paresthesias of the palmar surface of the ring and small fingers without proximal ulnar complaints.
  - iii. Later stages or types may affect ulnar innervated intrinsic muscle strength.

There are five types of the Guyon Canal Syndrome based on the anatomic area of compression and neurological signs. Testing should include strength of the adductor pollicis, abductor digiti minimi, and lumbricals ([Erkin, Uysal, Keles, Aybay, & Ozel, 2006](#)). Testing the ability of the long finger to cross the index finger is useful.

- d. **Diagnostic Testing Procedures:** Nerve conduction velocity studies of both sides for comparison to normal side. EMGs may be needed to rule out radiculopathy or more proximal ulnar nerve compression. When polyneuropathy is suspected, it may be worthwhile to perform electrodiagnostic testing in the lower extremities. Several sites of ulnar nerve entrapment at the wrist may be documented with electrodiagnostic testing.

MRI or ultrasound may be used to rule out space occupying lesions.

Diagnostic injections may be done to confirm the diagnosis.

- e. **Non-operative Treatment Procedures:**

- i. **Initial Treatment:** medications such as analgesics and over the counter medications for symptomatic relief, wrist bracing, splints,

restriction of activities and ergonomic changes. For those with mild symptoms lasting less than 3 months, a neutral wrist splint not immobilizing fingers may be tried ([Hoogvliet, Coert, Friden, & Huisstede, 2013](#)).

- ii. Patient education: should include instruction in self-management techniques, ergonomics, and a home therapy program. The provider should thoroughly discuss activities that may cause mechanical compression with the patient ([Hoogvliet et al., 2013](#)). Recurrence is common, so patient education regarding provocative activities is essential for long term recovery.
- iii. Job site evaluations and alterations: Ergonomic alterations should be done early to assure the appropriate changes are accomplished early in the treatment program.

Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite. Employers should consider applying the ergonomic changes to uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and Section H.6 Job Site Alteration.

- iv. Steroid injections: may decrease inflammation and allow the therapist to progress with rehabilitation therapy, although the Guyon's canal is narrow. Steroid injections under significant pressure should be avoided as the needle may be penetrating the tendon and injection into the tendon can cause possible tendon breakdown, tendon degeneration, or rupture.

- ❖ Time to Produce Effect: 1 injection.
- ❖ Maximum Frequency: 3 injections in 1 year spaced at least 4 to 8 weeks apart.

Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections. Refer to Section H.4 Injections for further details.

- v. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work for further details.
- vi. Other therapies in Section H Therapeutic Procedures – Non-Operative may be employed in individual cases.

f. **Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.

Surgery may be considered when: 1) findings on history and objective evidence correlate specifically with the diagnosis; 2) job site alteration and other conservative measures have not alleviated the symptoms; and 3) functional deficits persist after 6 to 8 weeks. Subjective complaints should be localized and appropriate to the diagnosis, neurologic complaints should be consistent with the nerve distribution in question, and physical exam findings should correlate with the history. Objective evidence should be present and includes: positive physical exam findings as described in Section G.3.c; positive electrodiagnostic (EDX) studies, diagnostic peripheral nerve block which eradicates the majority of the patient's symptoms, or a motor deficit commensurate with the suspected neurologic lesion.

Surgery may be considered as an initial therapy in situations where there is clinical and electrodiagnostic evidence of severe or progressive neuropathy.

Prior to surgical intervention, the patient and treating physician should identify functional operative goals, the likelihood of achieving improved ability to perform activities of daily living or work, and possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.

Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time, without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.

Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a

specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

- g. Operative Procedures:** ulnar nerve decompression at the wrist (ulnar tunnel release or Guyon's Canal release). Complications may occur and include infection, injury to the nerve, and deformity at the operative site.
- h. Post-operative Treatment:** an individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-Operative. In all cases, communication between the physician and therapist is important to the timing of exercise progressions. Treatment may include the following: bracing, scar management, edema control, ergonomic advice to prevent mechanical loading of the nerve, and active therapy with or without passive therapy. Splinting is usually not necessary unless protection from mechanical stress is needed or for severe pain ([Hoogvliet et al., 2013](#)).

Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon.

REFERENCED

#### 4. **POSTERIOR INTEROSSEOUS NERVE ENTRAPMENT (PIN)**

- a. **Description/Definition:** weakness of finger and thumb extension. Complaints of pain can be present. Symptoms are similar to radial tunnel syndrome.
- b. **Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections.
- c. **Specific Physical Exam Findings:** Required exam findings include weakness or inability to extend fingers or thumb with wrist in neutral or ulnar deviation. Usually can extend wrist in radial deviation. Weakness of thumb abduction usually occurs. If paresthesias in the radial nerve distribution or significant weakness of the wrist, suspect other diagnoses. Testing the ability of the long finger to cross the index finger is useful.
- d. **Diagnostic Testing Procedures:** nerve conduction velocity studies of both sides for comparison to normal side. EMGs may be needed to rule out radiculopathy. When polyneuropathy is suspected, it may be worthwhile to perform electrodiagnostic testing in the lower extremities. Diagnostic injections may be useful.  
  
MRI can be done if space occupying lesions are suspected.
- e. **Non-operative Treatment Procedures:**
  - i. Initial Treatment: medications such as analgesics and over the counter medications for symptomatic relief, splints, restriction of activities, ergonomic changes, stretching and exercise.
  - ii. Patient education: should include instruction in self-management techniques, ergonomics, and a home therapy program. Recurrence is common, so patient education regarding provocative activities is essential for long term recovery.
  - iii. Job site evaluations and alterations: Ergonomic alterations should be done early to assure the appropriate changes are accomplished early in the treatment program.
  - iv. Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite. Employers should consider applying the ergonomic changes to



uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and Section H.6 Job Site Alteration.

- v. Steroid injections: may decrease inflammation and allow the therapist to progress with rehabilitation therapy. Steroid injections under significant pressure should be avoided as the needle may be penetrating the tendon and injection into the tendon can cause possible tendon breakdown, tendon degeneration, or rupture.

- ❖ Time to Produce Effect: 1 injection.

- ❖ Maximum Frequency: 3 injections in 1 year spaced at least 4 to 8 weeks apart

Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections. Refer to Section H.4.c Steroid Injections for further details.

- vi. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work.

- vii. Other therapies in Section H Therapeutic Procedures – Non-Operative may be employed in individual cases.

- f. **Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.

Surgery may be considered when 1) findings on history and objective evidence correlate specifically with the diagnosis; 2) job site alteration and other conservative measures have not alleviated the symptoms; and 3) functional deficits persist after 8 to 10 weeks. Subjective complaints should be localized and appropriate to the diagnosis, neurologic complaints should be consistent with the nerve distribution in question, and physical exam findings of weakness should correlate with the history. Objective evidence should be present and may include: positive physical exam findings as described in section 6.c; positive electrodiagnostic (EDX) studies; or a motor deficit commensurate with the suspected neurologic lesion.

Surgery may be considered as an initial therapy in situations where there is clinical and electrodiagnostic evidence of severe or progressive neuropathy.

Prior to surgical intervention, the patient and treating physician should identify functional operative goals and the likelihood of achieving improved ability to perform activities of daily living or work, as well as possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.

Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time, without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.

Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

- g. Operative Procedures:** nerve decompression.
- h. Post-operative Treatment:** An individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-Operative. In all cases, communication between the physician and therapist is important to the timing of exercise progressions. Treatment may include the following: bracing, scar management and active therapy with or without passive therapy.

Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon.

## 5. **PRONATOR SYNDROME**

- a. **Description/Definition:** pain/paresthesias in median nerve distribution distal to elbow.
- b. **Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections.
- c. **Specific Physical Exam Findings:** Required elements for the diagnosis include paresthesias in the median nerve distribution and at least one of the following related exam findings:
  - i. Tingling in median nerve distribution on resisted pronation with elbow flexed at 90 degrees or elbow extended. When symptoms are reproduced with resisted elbow flexion in supination, the lacertus fibrosis may be responsible. The flexor digitorum superficialis may be responsible if symptoms are reproduced with resisted flexion of the proximal interphalangeal joint of the long finger ([Washington State Department of Labor and Industries, 2009](#)).
  - ii. Positive Tinel's at the proximal edge of the pronator teres muscle over the median nerve.

There may be sensation loss over the palm and over the thenar eminence which is not present with carpal tunnel syndrome ([Tsai & Beredjiklian, 2008](#)).
- d. **Diagnostic Testing Procedures:** X-rays of the elbow may be useful to rule out other conditions. Nerve conduction velocity tests of both extremities for comparison to normal; however, findings are frequently negative. EMG should always be included to test median nerve innervated muscles below and above the wrist to rule out carpal tunnel syndrome ([Bridgeman, Naidu, & Kothari, 2007](#)). When polyneuropathy is suspected, it may be worthwhile to perform electrodiagnostic testing in the lower extremities.
- e. **Non-operative Treatment Procedures:**
  - i. Initial Treatment: medications such as analgesics and over the counter medications for symptomatic relief; posterior elbow splint, wrist splint, and restriction of activities such as forceful gripping, and repetitive elbow flexion or forearm pronation.
  - ii. Patient education: should include instruction in self-management techniques, ergonomics, and a home therapy program. Recurrence is

common so patient education regarding provocative activities is essential for long term recovery.

- iii. Job site evaluations and alterations: Ergonomic alterations should be done early to assure the appropriate changes are accomplished early in the treatment program.
- iv. Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite. Employers should consider applying the ergonomic changes to uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and Section H.6 Job Site Alteration.
- v. Steroid injections: may decrease inflammation and allow the therapist to progress with rehabilitation therapy. Ultrasound guidance may be useful. Steroid injections under significant pressure should be avoided because the needle may penetrate the tendon and injection into the tendon can cause possible tendon breakdown, tendon degeneration, or rupture.
  - ❖ Time to Produce Effect: 1 injection.
  - ❖ Maximum Frequency: 3 injections in 1 year spaced at least 4 to 8 weeks apart.Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections. Refer to Section H.4.c Steroid Injections for further details.
- vi. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work.
- vii. Other therapies in Section H Therapeutic Procedures – Non-Operative may be employed in individual cases.

- f. **Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.

Most patients with this condition recover with conservative therapy. Surgery may be considered when: 1) findings on history and objective evidence correlate specifically with the diagnosis; and 2) job site alteration and other conservative measures have not alleviated the symptoms; and 3) functional deficits persist after 8 to 10 weeks. Subjective complaints should be localized and appropriate to the diagnosis, neurologic complaints should be consistent with the nerve distribution in question, and physical exam findings should correlate with the history. Objective evidence should be present and includes: positive physical exam findings as described in Section G.4.c; positive electrodiagnostic (EDX) studies; or a diagnostic peripheral nerve block which eradicates the majority of the patient's symptoms. Surgery may be considered as an initial therapy in situations where there is clinical and electrodiagnostic evidence of severe or progressive neuropathy.

When no objective evidence is present and the patient continues to have signs and symptoms consistent with the diagnosis after 6 months of conservative treatment including a psychological evaluation, a second opinion should be obtained before operative treatment is considered.

Electrodiagnostic (EDX) studies may show delayed median nerve conduction in the forearm. If nerve conduction velocity is normal with suggestive clinical findings, the study may be repeated after a 3 to 6 month period of continued conservative treatment. If the study is still normal, the decision on treatment is made based on the consistency of clinical findings and the factors noted above.

Prior to surgical intervention, the patient and treating physician should identify functional operative goals and the likelihood of achieving improved ability to perform activities of daily living or work, as well as possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.

Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time, without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.

Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

- g. Operative Procedures:** median nerve decompression in the forearm (pronator teres or flexor digitorum superficialis release).
- h. Post-operative Treatment:** An individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-Operative. Some motion is usually allowed 1 week after surgery ([Tsai & Beredjikian, 2008](#)). In all cases, communication between the physician and therapist is important to the timing of exercise progressions. Treatment may include the following: bracing, scar management, and active therapy with or without passive therapy.

Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon.

## **6. RADIAL TUNNEL SYNDROME**

- a. Description/Definition:** pain over the lateral posterior forearm. May occur in conjunction with and must be distinguished from lateral epicondylitis. Often includes paresthesias over the dorsal radial hand and wrist. Symptoms are similar to posterior interosseous nerve entrapment.
- b. Occupational Relationship:** Refer to Section D.3 Medical Causation Assessment for Cumulative Trauma Conditions. To perform a proper causation assessment, the reader must comply with all sections.
- c. Specific Physical Exam Findings:** The following two elements are required for the clinical diagnosis:
  - i.** Tenderness over the radial nerve near the proximal edge of the supinator muscle. This may be tested by applying pressure along the

radial nerve at points corresponding to the diameter of a half dollar beginning just distal to the elbow. At the third pressure point, no symptoms should be reproducible ([Stanley, 2006](#)). There may be subtle weakness of finger extension but weakness of wrist extension suggests nerve compression proximal to the radial tunnel as do sensation changes.

- ii. Resisted supination or resisted middle finger extension with the forearm pronated and extended reproduces symptoms ([Campbell & Landau, 2008](#)).

- d. **Diagnostic Testing Procedures:** nerve conduction velocity studies of both sides for comparison to normal side. EMGs may be needed to rule out radiculopathy. When polyneuropathy is suspected, it may be worthwhile to perform electrodiagnostic testing in the lower extremities. Electrodiagnostic (EDX) studies are helpful when positive. However, negative studies do not exclude the diagnosis.

MRI or ultrasound may be done if space occupying lesions are suspected.

X-rays may be normal or demonstrate spur formation over the involved epicondyle.

Diagnostic lidocaine injections may be used to confirm the diagnosis if surgery is being considered, as EMGs are frequently normal in this condition.

- e. **Non-operative Treatment Procedures:**

- i. Initial Treatment: medications such as analgesics and over the counter medications for symptomatic relief; restriction of activities and ergonomic changes. Most cases should respond to conservative treatment.
- ii. Patient education: should include instruction in self-management techniques, ergonomics, and a home therapy program. Recurrence is common, so patient education regarding provocative activities is essential for long term recovery.
- iii. Job site evaluations and alterations: Ergonomic alterations should be done early to assure the appropriate changes are accomplished early in the treatment program.

Whenever a case is identified as a work-related cumulative trauma condition, job alterations are an expected treatment. These may be in the form of: 1) instructing the worker how specific duties might be

performed to meet ergonomic standards; 2) actual job worksite or duty changes; and/or 3) a formal job site evaluation at the worksite. Employers should consider applying the ergonomic changes to uninjured workers in the same job position. Refer to Section E.6.c Job Site Evaluations and Section H.6 Job Site Alteration.

- iv. Steroid injections: may decrease inflammation and allow the therapist to progress with rehabilitation therapy. Steroid injections under significant pressure should be avoided as the needle may be penetrating the tendon and injection into the tendon can cause tendon breakdown, tendon degeneration, or rupture.

- ❖ Time to Produce Effect: 1 injection.

- ❖ Maximum Frequency: 3 injections in 1 year spaced at least 4 to 8 weeks apart.

Steroid injections should be used cautiously in diabetic patients. Diabetic patients should be reminded to check their blood glucose levels at least daily for 2 weeks after injections. Refer to Section H.4.c Steroid Injections for further details.

- v. Return to work with appropriate restrictions should be considered early in the course of treatment. Refer to Section H.11 Return-to-Work.
- vi. Other therapies in Section H Therapeutic Procedures – Non-Operative may be employed in individual cases.

- f. **Surgical Indications/Considerations:** Since cumulative trauma conditions often involve several areas in an upper extremity, surgical treatment of one problem should be performed in conjunction with conservative treatment of other problems in the upper extremity.

Surgery may be considered when: 1) findings on history and objective evidence correlate specifically with the diagnosis; 2) job site alteration and other conservative measures have not alleviated the symptoms; and 3) functional deficits persist after 8 to 10 weeks. Subjective complaints should be localized and appropriate to the diagnosis, neurologic complaints should be consistent with the nerve distribution in question, and physical exam findings should correlate with the history. Objective evidence should be present and includes: positive physical exam findings as described in Section G.5.c.; positive electrodiagnostic (EDX) studies, or diagnostic peripheral nerve block which eradicates the majority of the patient's symptoms.



When no objective evidence is present and the patient continues to have signs and symptoms consistent with the diagnosis after 6 months of conservative treatment and a psychological evaluation, a second opinion should be obtained before operative treatment is considered ([B. Huisstede et al., 2008](#)).

Most cases improve with conservative treatment. Surgery should only be performed to achieve functional gains on those with significant ongoing impaired activities of daily living.

Complications: Radial nerve decompression is reported to have good success. However, complications can occur and include infection, damage to the posterior interosseous nerve, or damage to the extensor carpi radialis brevis or extensor digitorum communis ([Henry & Stutz, 2006](#); [B. Huisstede et al., 2008](#)).

Prior to surgical intervention, the patient and treating physician should identify functional operative goals, the likelihood of achieving improved ability to perform activities of daily living or work, and possible complications. The patient should agree to comply with the pre- and post-operative treatment plan including home exercise. The provider should be especially careful to make sure the patient understands the amount of post-operative therapy required and the length of partial- and full-disability expected post-operatively.

Informed decision making should be documented for all invasive procedures. This must include a thorough discussion of the pros and cons of the procedure and the possible complications as well as the natural history of the identified diagnosis. Since many patients with the most common conditions will improve significantly over time, without invasive interventions, patients must be able to make well-informed decisions regarding their treatment.

Smoking may affect soft tissue healing through tissue hypoxia. Patients should be strongly encouraged to stop smoking and be provided with appropriate counseling by the physician. If a treating physician recommends a specific smoking cessation program peri-operatively, this should be covered by the insurer. Typically the patient should show some progress toward cessation at about six weeks. Physicians may monitor smoking cessation with laboratory tests such as cotinine levels. The surgeon will make the final determination as to whether smoking cessation is required prior to surgery. Patients with demonstrated success may continue the program up to 3 months or longer if needed based on the operative procedure. Refer to Section H.7.f Smoking Cessation Medications and Treatment for further details.

g. **Operative Procedures:** radial nerve decompression.

h. **Post-operative Treatment:**

- i. An individualized rehabilitation program based upon communication between the surgeon and the therapist using therapies as outlined in Section H Therapeutic Procedures – Non-Operative. In all cases, communication between the physician and therapist is important to the timing of exercise progressions.
- ii. Treatment may include the following: bracing, scar management and active therapy with or without passive therapy. Stretching is usually started early and strengthening may begin 3 to 6 weeks after surgery. Recovery is expected to last no longer than 4 months ([Henry & Stutz, 2006](#)).
- iii. Return to work and restrictions after surgery may be made by an attending physician experienced in occupational medicine in consultation with the surgeon or by the surgeon.

REFERENCED

## H. THERAPEUTIC PROCEDURES – NON-OPERATIVE

Treating providers, employers, and insurers are highly encouraged to reference Section B General Guidelines Principles before initiating any therapeutic procedure. All treatment plans should specify frequency, duration, and expected treatment milestones. Before initiation of any therapeutic procedure, the authorized treating provider, employer, and insurer must consider these important issues in the care of the injured worker.

*First*, patients undergoing therapeutic procedure(s) should be released or returned to modified- or restricted-duty during their rehabilitation at the earliest appropriate time. Refer to Section H.11 Return-to-Work for detailed information.

*Second*, cessation and/or review of treatment modalities should be undertaken when no further significant subjective or objective improvement in the patient's condition is noted. If patients are not responding within the recommended duration periods, alternative treatment interventions, further diagnostic studies, or consultations should be pursued.

*Third*, providers should provide and document patient education. Functional progression is expected through prescribed activity such as neuromuscular and postural re-education/re-patterning exercises. Before diagnostic tests or referrals for invasive treatment take place, the patient should be able to clearly articulate the goals of the intervention, the general side effects, and associated risks, as well as agree with the expected treatment plan.

*Lastly*, formal psychological or psychosocial evaluation should be performed on patients not making expected progress within 6 to 12 weeks following injury and whose subjective symptoms do not correlate with objective signs and tests.

Home therapy is an important component of therapy and may include active and passive therapeutic procedures as well as other modalities to assist in alleviating pain, swelling, and abnormal muscle tone.

### 1. ACUPUNCTURE

**ACUPUNCTURE:** When acupuncture has been studied in randomized clinical trials, it is often compared with sham acupuncture and/or no acupuncture (usual care). The differences between true acupuncture and usual care have been moderate but clinically important. These differences can be partitioned into two components: non-specific effects and specific effects. Non-specific effects include patient beliefs and expectations, attention from the acupuncturist, administration of acupuncture in a relaxing setting, and other components of what is often called the placebo effect. Specific effects refer to any additional effects which occur in the same setting of expectations and attention, but they are attributable to the penetration of the skin in the specific, classic acupuncture points on the surface of the body by the needles themselves.

A sham procedure is a non-therapeutic procedure that appears similar to the patient as the purported therapeutic procedure being tested. In most controlled studies, sham and classic acupuncture have produced similar effects. However, the sham controlled studies have shown consistent advantages of both true and sham acupuncture over no acupuncture when the studies have included a third comparison group that was randomized to usual medical care. Having this third comparison group has helped to interpret the non-specific effects of acupuncture, since the third comparison group controls for some influences on study outcome. These influences include more frequent contact with providers, the natural history of the condition, regression to the mean, the effect of being observed in a clinical trial, and--if the follow-up observations are done consistently in all three treatment groups--biased reporting of outcomes. Controlling for these factors enables researchers to more closely estimate the contextual and personal interactive effects of acupuncture as it is generally practiced.

Clinical trials of acupuncture typically enroll participants who are interested in acupuncture, and who may respond to some of the non-specific aspects of the intervention more than patients who have no interest in or desire for acupuncture. The non-specific effects of acupuncture may not be produced in patients who have no wish to be referred for it.

Another study provides good evidence that true acupuncture at traditional meridians is marginally better than sham acupuncture with blunt needles in reducing pain, but effects on disability are unclear ([Cho et al., 2013](#)). In these studies, 5–15 treatments were provided. Comparisons of acupuncture and sham acupuncture have been inconsistent, and the advantage of true over sham acupuncture has been small in relation to the advantage of sham over no acupuncture.

Acupuncture is recommended for subacute or chronic pain patients who are trying to increase function and/or decrease medication usage and have an expressed interest in this modality. It is also recommended for subacute or acute pain for patients who cannot tolerate NSAIDs or other medications.

Acupuncture is not the same procedure as dry needling for coding purposes. However, some acupuncturists may use acupuncture treatment for myofascial trigger points. Dry needling is performed specifically on myofascial trigger points. Refer to Section H.4.d Trigger Point Injections.

Acupuncture should generally be used in conjunction with manipulative and physical therapy/rehabilitation.

Credentialed practitioners with experience in evaluation and treatment of chronic pain patients must evaluate prior to acupuncture treatments. The exact mode of action is only partially understood. Western medicine studies suggest that acupuncture stimulates the nervous system at the level of the brain, promotes deep relaxation, and affects the release of neurotransmitters. Acupuncture is commonly used as an

alternative or in addition to traditional Western pharmaceuticals. It may be used when pain medication is reduced or not tolerated; as an adjunct to physical rehabilitation and surgical intervention; and/or as part of multidisciplinary treatment to hasten the return of functional activity. Acupuncture must be performed by practitioners with the appropriate credentials in accordance with state and other applicable regulations. Therefore, if not otherwise within their professional scope of practice and licensure, those performing acupuncture must have the appropriate credentials, such as L.A.c. R.A.c, or Dipl. Ac.

There is some evidence that acupuncture has a very short term 2 week effect on pain compared to sham acupuncture for lateral epicondylitis ([Fink et al., 2002](#)).

Indications: All patients being considered for acupuncture treatment should have subacute or chronic pain (lasting approximately 3-4 weeks depending on the condition) and meet the following criteria:

- they should have participated in an initial active therapy program; and
  - they should show a clear preference for this type of care or previously have benefited from acupuncture; and
  - they must continue to be actively engaged in physical rehabilitation therapy and return to work.
- a. **Acupuncture:** is the insertion and removal of filiform needles to stimulate acupoints (acupuncture points). Needles may be inserted, manipulated and retained for a period of time. Acupuncture can be used to reduce pain, reduce inflammation, increase blood flow, increase range-of-motion, decrease the side effect of medication-induced nausea, relax an anxious patient, and reduce muscle spasm.

Indications include joint pain, joint stiffness, soft tissue pain and inflammation, paresthesia, post-surgical pain relief, muscle spasm, and scar tissue pain.

- b. **Acupuncture with Electrical Stimulation:** is the use of electrical current (micro-amperage or milli-amperage) on the needles at the acupuncture site. It is used to increase effectiveness of the needles by continuous stimulation of the acupoint. Physiological effects (depending on location and settings) can include endorphin release for pain relief, reduction of inflammation, increased blood circulation, analgesia through interruption of pain stimulus, and muscle relaxation.

It is indicated to treat chronic pain conditions, radiating pain along a nerve pathway, muscle spasm, inflammation, scar tissue pain, and pain located in multiple sites.

- c. **Total Time Frames for Acupuncture & Acupuncture with Electrical Stimulation**: Time frames are not meant to be applied to each of the above sections separately. The time frames are to be applied to all acupuncture treatments regardless of the type or combination of therapies being provided.

- ❖ Time to Produce Effect: 3 to 6 treatments.
- ❖ Frequency: 1 to 3 times per week.
- ❖ Optimum Duration: 1 to 2 months.
- ❖ Maximum Duration: 14 treatments.

Any of the above acupuncture treatments may extend longer if objective functional gains can be documented and symptomatic benefits facilitate progression in the patient's treatment program. Treatment beyond 14 treatments must be documented with respect to need and ability to facilitate positive symptomatic or functional gains. Such care should be re-evaluated and documented with each series of treatments.

- d. **Other Acupuncture Modalities**: Acupuncture treatment is based on individual patient needs and therefore may include a combination of procedures to enhance treatment effect. Other procedures may include the use of heat, soft tissue manipulation/massage, and exercise. Refer to Section H.13 Therapy-Active (Therapeutic Exercise) and Section H.14 Therapy-Passive (Massage and Superficial Heat and Cold Therapy) for a description of these adjunctive acupuncture modalities and time frames.

## 2. **BIOFEEDBACK**

**BIOFEEDBACK**: Biofeedback is a form of behavioral medicine that helps patients learn self-awareness and self-regulation skills to increase control of their physiology, such as muscle activity, brain waves, and measures of autonomic nervous system activity. Stress-related psycho-physiological reactions may arise as a reaction to organic pain and in some cases may cause pain. Electronic instrumentation is used to monitor the targeted physiology and then displayed or fed back to the patient visually, auditorily, or tactilely, with coaching by a biofeedback specialist. There is good evidence that biofeedback or relaxation therapy is equal in effect to cognitive behavioral therapy for chronic low back pain ([Hoffman, Papas, Chatkoff, & Kerns, 2007](#)).

Indications for biofeedback include cases of musculoskeletal injury, in which muscle dysfunction or other physiological indicators of excessive or prolonged stress response affects and/or delays recovery. Other applications include training to improve self-management of pain, anxiety, panic, anger or emotional distress, opioid

withdrawal, insomnia/sleep disturbance, and other central and autonomic nervous system imbalances. Biofeedback is often utilized for relaxation training. Mental health professionals may also utilize it as a component of psychotherapy, where biofeedback and other behavioral techniques are integrated with psychotherapeutic interventions. Biofeedback is often used in conjunction with physical therapy or medical treatment.

- ❖ Time to Produce Effect: 3 to 4 sessions.
- ❖ Frequency: 1 to 2 times per week.
- ❖ Optimum Duration: 5 to 6 sessions.
- ❖ Maximum Duration: 10 to 12 sessions. Treatment beyond 12 sessions must be documented with respect to need, expectation, and ability to facilitate functional gains.

### 3. **EDUCATION/INFORMED DECISION MAKING**

**EDUCATION/INFORMED DECISION MAKING:** of patients, families, employers, insurers, policy makers, and the community should be the primary emphasis in the treatment of shoulder pain and disability. Unfortunately, practitioners often think of education and informed decision making last, after medications, manual therapy, and surgery.

Informed decision making is the hallmark of a successful treatment plan. In most cases, the continuum of treatment from the least invasive to the most invasive (e.g., surgery) should be discussed. The intention is to find the treatment along this continuum which most completely addresses the condition. Patients should identify their personal functional goals of treatment at the first visit. It is recommended that specific individual goals are articulated at the beginning of treatment as this is likely to lead to increased patient satisfaction above that achieved from improvement in pain or other physical function ([Hazard et al., 2009](#)). Progress toward the individual functional goals identified should be addressed at follow up visits and throughout treatment by other members of the health care team as well as the authorized physicians.

Documentation of this process should occur whenever diagnostic tests or referrals from the authorized treating physician are contemplated. The informed decision making process asks the patients to set their personal functional goals of treatment, describe their current health status and any concerns they have regarding adhering to the diagnostic or treatment plan proposed. The provider should clearly describe the following:

- a. The expected functional outcomes from the proposed treatment, or expected results and plan of action if diagnostic tests are involved.
- b. Any side effects and risks to the patient.
- c. Required post treatment rehabilitation time and impact on work, if any.
- d. Alternative therapies or diagnostic testing.

Before diagnostic tests or referrals for invasive treatment take place, the patient should be able to clearly articulate the goals of the intervention, the general side effects and risks associated with it, and their decision regarding compliance with the suggested plan. There is some evidence that information provided only by video is not sufficient education ([Newcomer, Vickers Douglas, Shelerud, Long, & Crawford, 2008](#)).

Practitioners must develop and implement an effective strategy and skills to educate patients, employers, insurance systems, policy makers, and the community as a whole. An education-based paradigm should always start with reassuring information to the patient and informed decision making. More in-depth education currently exists within a treatment regimen employing functional restoration, prevention, and cognitive behavioral techniques. Patient education and informed decision making should facilitate self-management of symptoms and prevention.

- ❖ Time to produce effect: Varies with individual patient
- ❖ Frequency: Should occur at every visit.

#### 4. **INJECTIONS – THERAPEUTIC**

**INJECTIONS – THERAPEUTIC:** are generally accepted, well-established procedures that may play a significant role in the treatment of patients with upper extremity pain or pathology. Therapeutic injections involve the delivery of anesthetic and/or anti-inflammatory medications to the painful structure. Therapeutic injections have many potential benefits. Ideally, a therapeutic injection will: (a) reduce inflammation in a specific target area; (b) relieve secondary muscle spasm; and (c) diminish pain and support therapy directed to functional recovery. Diagnostic and therapeutic injections should be used early and selectively to establish a diagnosis and support rehabilitation. If injections are overused or used outside the context of a monitored rehabilitation program, they may be of significantly less value.

Special Considerations: The use of injections has become progressively sophisticated. Each procedure considered has an inherent risk. Risk versus benefit should be



evaluated when considering injection therapy. In addition, all injections must include sterile technique.

Contraindications: General contraindications include local or systemic infection, bleeding disorders, allergy to medications used, and patient refusal. Specific contraindications may apply to individual injections.

**a. Autologous Whole Blood Injections/Platelet-Rich Plasma Injections:**

- i. Autologous Whole Blood Injections: Autologous whole blood injections are inexpensive and may be used in patients who have not made sufficient functional progress with initial therapy for lateral or medial epicondylitis after 10 to 12 weeks. Refer to Section F.3.g Non-operative Treatment Procedures (Epicondylitis) and Section F.4.e Non-operative Treatment Procedures (Extensor Tendon Disorders).

There is some evidence in literature on lateral epicondylitis that, for patients with symptoms lasting 6 months or more, autologous blood injections result in better pain and functional outcomes after 1 year than steroid injections ([Ozturan et al., 2010](#)).

- ii. Platelet-Rich Plasma (PRP) Injections: There is good evidence in literature on lateral epicondylitis that, for patients with symptoms lasting 6 months or more, platelet-rich plasma injections result in better pain and functional outcomes after 1 year than steroid injections ([Peerbooms et al., 2010](#)).

There is good evidence that, in the setting of lateral epicondylitis, PRP may lead to a small to moderate functional benefit in comparison to autologous whole blood or saline at two to three months, but effects on pain are uncertain ([Cochrane] [Moraes et al., 2013](#)).

There is good evidence that PRP produces more favorable symptomatic and functional improvement than triamcinolone injection in patients with chronic lateral epicondylitis, with this advantage persisting for 24 months after treatment ([Gosens et al., 2011](#)).

In summary, there is strong evidence for the use of PRP in patients who have not improved with conservative therapy. Ultrasound guided may be useful.

- ❖ Optimum frequency: 2 injections may be required

- b. **Botulinum Toxin Injections:** Botulinum toxin treats lateral and medial epicondylitis by reversibly paralyzing the extensor muscles and thereby preventing repetitive micro-trauma of the tendonous fibers at their origin from the osseous lateral/medial epicondyle. The unit dosage varies significantly depending on the brand used. Usage for lateral and medial epicondylitis is not FDA approved at the time of this guideline writing. There is good evidence that botulinum toxin A injection may provide short-term pain relief from pain due to chronic (3 months or longer) lateral epicondylitis ([Espandar et al., 2010](#); [Placzek et al., 2007](#); [Wong et al., 2005](#)). However, the long-term functional benefits are unknown. There is also good evidence that botulinum toxin A injections cause weakness in finger extension and/or digit paresis ([Espandar et al., 2010](#); [Placzek et al., 2007](#); [Wong et al., 2005](#)). Additional complications may include: allergic reaction to medications, increased risk of systemic effects in patients with motor neuropathy or disorders of the neuromuscular junction.

Botulinum toxin injections should not be considered a first line of treatment. Other conservative measures should be tried first. Careful botulinum toxin dosing should be used to avoid complete paresis and maintain function and return to work.

Botulinum toxin injections are listed in this guideline as a treatment option for lateral and medial epicondylitis. **Prior authorization is required.** For more specific details, the reader must refer to Section F.3.g Non-operative Treatment Procedures (Epicondylitis) and Section F.4.e Non-operative Treatment Procedures (Extensor Tendon Disorders).

- ❖ Maximum: 1 injection per episode of symptomatic treatment (for some conditions there may be re-occurrences).

- c. **Steroid Injections:** including joint, bursa and peri-tendonous insertions are well-established procedures with varying degrees of evidence depending on the diagnosis. Peri-tendonous injections under significant pressure should be avoided as the needle may inadvertently penetrate the tendon. Injection into the tendon can cause tendon degeneration, tendon breakdown, or rupture. When performing peri-tendonous injections, the risk of tendon rupture should be discussed with the patient and the need for temporary restricted-duty emphasized.

There is strong evidence that, in the setting of lateral epicondylitis, the effects of corticosteroid injections on pain and function are more favorable than placebo in the first four weeks, but these benefits are reversed by six months. In addition, corticosteroid injections are detrimental compared to placebo injections in the intermediate and long term ([Arik et al., 2014](#); [Coombes et al.,](#)

[2010](#); [Kucuksen et al., 2013](#); [Mardani-Kivi et al., 2013](#); [Peerbooms et al., 2010](#)).

There is some evidence for steroid injections as a short term treatment in carpal tunnel syndrome. Refer to Section G.1 Carpal Tunnel Syndrome for more details.

General complications of injections may include transient neurapraxia, nerve injury, infection, hematoma, glucose elevation, and endocrine changes.

The majority of diabetic patients will experience an increase in glucose following steroid injections. Average increases in one study were 125mg/dL and returned to normal in 48 hours ([Even, Crosby, Song, McGirt, & Devin, 2012](#)). In other studies, the increased glucose levels remained elevated up to 7 days, especially after multiple injections ([Even et al., 2012](#); [Gonzalez, Laker, Sullivan, Harwood, & Akuthota, 2009](#); [Habib & Miari, 2011](#); [Moon et al., 2014](#); [Ward, Watson, Wood, Dunne, & Kerr, 2002](#); [Younes et al., 2007](#)). All diabetic patients should be told to follow their glucose levels carefully over the 7 days after a steroid injection. For patients who have not been diagnosed with diabetes, one can expect some increase in glucose due to insulin resistance for a few days after a steroid injection. Clinicians should consider diabetic screening tests for those who appear to be at risk for type 2 diabetes and checking hemoglobin A1c and/or glucose for diabetics. Caution should be used when considering steroid injections for patients with an A1c level of 8% or greater ([Shilling & Raphael, 2008](#)).

Intra-articular or epidural injections cause rapid drops in plasma cortisol levels which usually resolve in one to 4 weeks ([Moon et al., 2014](#); [Younes et al., 2007](#)). There is some evidence that an intra-articular injection of 80 mg of methylprednisolone acetate into the knee has about a 25% probability of suppressing the adrenal gland response to exogenous adrenocorticotrophic hormone ACTH for four or more weeks after injection, but complete recovery of the adrenal response is seen by week 8 after injection ([Habib & Miari, 2011](#); [Moon et al., 2014](#); [Younes et al., 2007](#)). This adrenal suppression could require treatment if surgery or other physiologically stressful events occur.

Case reports of Cushing's syndrome, hypopituitarism and growth hormone deficiency have been reported uncommonly and have been tied to systemic absorption of intra-articular and epidural steroid injections ([Lansang, Farmer, & Kennedy, 2009](#)). Cushing's syndrome has also been reported from serial occipital nerve injections and paraspinal injections ([Edmonds, Vance, & Hughes, 1991](#); [Lansang et al., 2009](#); [Lavin & Workman, 2001](#)).

Morning cortisol measurements may be ordered prior to repeating steroid injections or prior to the initial steroid injection when the patient has received multiple previous steroid injections.

Given this information regarding increase in blood glucose levels, effects on the endocrine system, and possible osteoporotic influence, it is suggested that intra-articular and epidural injections be limited to a total of 3 to 4 per year [*all joints combined*] ([Caldwell, 1996](#); [Jones, Kelsberg, & Safranek, 2014](#); [Khan, Abbas, Williamson, & Balart, 2013](#); [Ostergaard & Halberg, 1998](#)). For further specific recommendations, refer to diagnostic sections of this guideline.

- ❖ Time to Produce Effect: Immediate with local anesthesia, or within 3 days if no anesthesia.
- ❖ Optimum Duration: Usually 1 to 2 injections is adequate.
- ❖ Maximum Frequency: Not more than 3 to 4 times annually.

- d. **Trigger Point Injections:** Although generally accepted, have only rare indications in the treatment of cumulative trauma disorders. Therefore, the Division does not recommend their routine use in the treatment cumulative trauma disorders.

Description: Trigger point injections and dry needling are both generally accepted treatments. Trigger point treatments can consist of dry needling or the injection of local anesthetic, with or without corticosteroid, into highly localized, extremely sensitive bands of skeletal muscle fibers. These muscle fibers produce local and referred pain when activated. Medication is injected in a four-quadrant manner in the area of maximum tenderness. Injection and dry needling efficacy can be enhanced if treatments are immediately followed by myofascial therapeutic interventions, such as vapo-coolant spray and stretch, ischemic pressure massage (myotherapy), specific soft tissue mobilization and physical modalities. There is conflicting evidence regarding the benefit of trigger point injections ([Cochrane] ([Staal, de Bie, de Vet, Hildebrandt, & Nelemans, 2008](#))). A truly blinded study comparing dry needle treatment of trigger points is not feasible. There is no evidence that injection of medications improves the results of trigger-point injections ([Cochrane] ([Staal et al., 2008](#))). Needling alone may account for some of the therapeutic response of injections. Needling must be performed by practitioners with the appropriate credentials in accordance with state and other applicable regulations.

There is no indication for conscious sedation for patients receiving trigger point injections or dry needling. The patient must be alert to help identify the site of the injection.

Indications: Trigger point injections and dry needling may be used to relieve myofascial pain and facilitate active therapy and stretching of the affected areas. They are to be used as an adjunctive treatment in combination with other treatment modalities such as active therapy programs. Trigger point injections should be utilized primarily to facilitate functional progress. Patients should continue in an aggressive aerobic and stretching therapeutic exercise program, as tolerated, while undergoing intensive myofascial interventions. Myofascial pain is often associated with other underlying structural problems. Any abnormalities need to be ruled out prior to injection.

Trigger point injections and dry needling are indicated in patients with consistently observed, well-circumscribed trigger points. Trigger point injections and dry needling may demonstrate a local twitch response, characteristic radiation of pain pattern, and local autonomic reaction such as persistent hyperemia following palpation. Generally, neither trigger point injections nor dry needling are necessary unless consistently observed trigger points are not responding to specific, noninvasive, myofascial interventions within approximately a 6-week time frame. However, both trigger point injections and dry needling may be occasionally effective when utilized in the patient with immediate, acute onset of pain or in a post-operative patient with persistent muscle spasm or myofascial pain.

Complications: Potential but rare complications of trigger point injections and dry needling include infection, pneumothorax, anaphylaxis, penetration of viscera, neurapraxia, and neuropathy. If corticosteroids are injected in addition to local anesthetic, there is a risk of local myopathy. Severe pain on injection suggests the possibility of an intraneural injection, and the needle should be immediately repositioned. The following treatment parameters apply to both interventions combined.

- ❖ Time to produce effect: Local anesthetic 30 minutes; 24 to 48 hours for no anesthesia.
- ❖ Frequency: Weekly. Suggest no more than 4 injection sites per session per week to avoid significant post-injection or post-needling soreness.
- ❖ Optimum duration: 4 weeks total for all sites.

- ❖ Maximum duration: 8 weeks total for all sites. Occasional patients may require 2 to 4 repetitions of trigger point injection or dry needling series over a 1 to 2 year period.

- e. **Prolotherapy:** (also known as sclerotherapy) consists of peri-articular injections of hypertonic dextrose with or without phenol. The goal of prolotherapy is to induce an inflammatory response that will recruit cytokine growth factors involved in the proliferation of connective tissue. Advocates of prolotherapy propose that these injections will alleviate complaints related to joint laxity by promoting the growth of connective tissue and stabilizing the involved joint.

Laboratory studies may lend some biological plausibility to claims of connective tissue growth, but high quality published clinical studies are lacking. The dependence of the therapeutic effect on the inflammatory response is poorly defined, raising concerns about the use of conventional anti-inflammatory drugs when proliferate injections are given. There is no evidence that prolotherapy compared to a steroid injection for aggravated carpometacarpal arthritis provides a clinically meaningful advantage ([Jahangiri, Moghaddam, & Najafi, 2014](#)). Therefore, it is **not recommended**.

- f. **Viscosupplementation/Intracapsular Acid Salts:** involves the injection of hyaluronic acid and its derivatives into the joint space. Hyaluronic acid is normally secreted by the healthy synovium into the joint space and functions to lubricate the joint and protect the cartilage. These injections may only be used for osteoarthritis.

There is no evidence that hyaluronate injections are superior to steroid injections for carpometacarpal thumb arthritis ([Fuchs et al., 2006](#); [Heyworth et al., 2008](#); [Monfort et al., 2015](#); [Roux et al., 2007](#); [Spaans et al., 2015](#); [Stahl et al., 2005](#)). There is some evidence that intra-articular hyaluronan is not superior to placebo for improving pain in the setting of carpometacarpal osteoarthritis and that it does not improve function in a clinically important way in the first six months after injection ([Figen Ayhan & Ustun, 2009](#); [Mandl et al., 2012](#)). Therefore, they are **not recommended**.

## 5. **INTERDISCIPLINARY REHABILITATION PROGRAMS**

**INTERDISCIPLINARY REHABILITATION PROGRAMS:** This is the gold standard of treatment for individuals who have not responded to less intensive modes of treatment. There is good evidence that interdisciplinary programs that include screening for psychological issues, identification of fear-avoidance beliefs and treatment barriers, and establishment of individual functional and work goals will improve function and decrease disability ([Dobscha et al., 2009](#); [Lambeek, van Mechelen, Knol, Loisel, & Anema, 2010](#)). These programs should assess the impact of

pain and suffering on the patient's medical, physical, psychological, social, and/or vocational functioning. In general, interdisciplinary programs evaluate and treat multiple and sometimes irreversible conditions. These conditions include, but are not limited to, painful musculoskeletal, neurological, and other chronic pain conditions and psychological issues; drug dependence, abuse, or addiction; high levels of stress and anxiety; failed surgery; and pre-existing or latent psychopathology. The number of professionals on the team in a chronic pain program may vary due to the complexity of the needs of the person served. The Division recommends consideration of referral to an interdisciplinary program within six months post-injury in patients with delayed recovery, unless successful surgical interventions or other medical and/or psychological treatment complications are at issue.

Chronic pain patients need to be treated as outpatients within a continuum of treatment intensity. Outpatient chronic pain programs are available with services provided by a coordinated interdisciplinary team within the same facility (formal) or as coordinated among practices by the authorized treating physician (informal). Formal programs are able to provide a coordinated, high-intensity level of services and are recommended for most chronic pain patients who have received multiple therapies during acute management.

Patients with addiction problems, high-dose opioid use, or abuse of other drugs may require inpatient and/or outpatient chemical dependency treatment programs before or in conjunction with other interdisciplinary rehabilitation. Guidelines from the American Society of Addiction Medicine are available and may be consulted relating to the intensity of services required for different classes of patients in order to achieve successful treatment.

Informal interdisciplinary pain programs may be considered for patients who are currently employed, those who cannot attend all-day programs, those with language barriers, or those living in areas not offering formal programs. Before treatment has been initiated, the patient, physician, and insurer should agree on treatment approach, methods, and goals. Generally, the type of outpatient program needed will depend on the degree of impact the pain has had on the patient's medical, physical, psychological, social, and/or vocational functioning.

When referring a patient for formal outpatient interdisciplinary pain rehabilitation, an occupational rehabilitation program, or an opioid treatment program, the Division recommends the program meets the criteria of the Commission on Accreditation of Rehabilitation Facilities (CARF).

Inpatient pain rehabilitation programs are rarely needed but may be necessary for patients with any of the following conditions: (a) high risk for medical instability; (b) moderate-to-severe impairment of physical/functional status; (c) moderate-to-severe pain behaviors; (d) moderate impairment of cognitive and/or emotional status; (e) dependence on medications from which he/she needs to be withdrawn; and (f) the

need for 24-hour supervised nursing. Whether formal or informal programs, programs should have the following dimensions ([CARF, 2010-2011](#)):

- **Communication:** To ensure positive functional outcomes, communication between the patient, insurer, and all professionals involved must be coordinated and consistent. Any exchange of information must be provided to all parties, including the patient. Care decisions should be communicated to all parties and should include the family and/or support system.
- **Documentation:** Through documentation by all professionals involved and/or discussions with the patient, it should be clear that functional goals are being actively pursued and measured on a regular basis to determine their achievement or need for modification. It is advisable to have the patient undergo objective functional measures.
- **Treatment Modalities:** Use of modalities may be necessary early in the process to facilitate compliance with and tolerance to therapeutic exercise, physical conditioning, and increasing functional activities. Active treatments should be emphasized over passive treatments. Active and self-monitored passive treatments should encourage self-coping skills and management of pain, which can be continued independently at home or at work. Treatments that can foster a sense of dependency by the patient on the caregiver should be avoided. Treatment length should be decided based upon observed functional improvement. For a complete list of active and passive therapies, refer to Section H.13 Therapy – Active and H.14 Therapy – Passive. All treatment timeframes may be extended based on the patient's positive functional improvement.
- **Therapeutic Exercise Programs:** A therapeutic exercise program should be initiated at the start of any treatment rehabilitation. Such programs should emphasize education, independence, and the importance of an on-going exercise regimen. There is good evidence that exercise, alone or as part of a multi-disciplinary program, results in decreased disability for workers with non-acute low back pain ([Oesch, Kool, Hagen, & Bachmann, 2010](#)). There is not sufficient evidence to support the recommendation of any particular exercise regimen over any other exercise regimen.
- **Return-to-Work:** The authorized treating physician should continually evaluate the patients for their potential to return to work. For patients who are currently employed, efforts should be aimed at keeping them employed. Formal rehabilitation programs should provide assistance in creating work profiles. For more specific information regarding return to work, refer to H.11 Return-to-Work.
- **Patient Education:** Patients with pain need to re-establish a healthy balance in lifestyle. All providers should educate patients on how to overcome barriers to



resuming daily activity, including pain management, decreased energy levels, financial constraints, decreased physical ability, and change in family dynamics.

- **Psychosocial Evaluation and Treatment:** Psychosocial evaluation should be initiated, if not previously done. Providers should have a thorough understanding of the patient's personality profile, especially if dependency issues are involved. Psychosocial treatment may enhance the patient's ability to participate in pain treatment rehabilitation, manage stress, and increase their problem-solving and self-management skills.
- **Vocational Assistance:** Vocational assistance can define future employment opportunities or assist patients in obtaining future employment. Refer to H.11 Return-to-Work for detailed information.
- **Interdisciplinary programs** are characterized by a variety of disciplines that participate in the assessment, planning, and/or implementation of the treatment program. These programs are for patients with greater levels of perceived disability, dysfunction, de-conditioning, and psychological involvement. Programs should have sufficient personnel to work with the individual in the following areas: behavioral, functional, medical, cognitive, pain management, psychological, social, and vocational.

a. **Formal Interdisciplinary Rehabilitation Programs:**

- i. **Interdisciplinary Pain Rehabilitation:** An Interdisciplinary Pain Rehabilitation Program provides outcome-focused, coordinated, goal-oriented interdisciplinary team services to measure and improve the functioning of persons with pain and encourage their appropriate use of health care system and services. The program can benefit persons who have limitations that interfere with their physical, psychological, social, and/or vocational functioning. The program shares information about the scope of the services and the outcomes achieved with patients, authorized providers, and insurers.

The interdisciplinary team maintains consistent integration and communication to ensure that all team members are aware of the plan of care for the patient, are exchanging information, and implement the plan of care. The team members make interdisciplinary team decisions with the patient and then ensure that decisions are communicated to the entire care team.

The Medical Director of the pain program should ideally be board certified in pain management. Alternatively, he/she should be board certified in his/her specialty area and have completed a one-year

fellowship in interdisciplinary pain medicine or palliative care recognized by a national board. As a final alternative, he or she should have two years of experience in an interdisciplinary pain rehabilitation program. Teams that assist in the accomplishment of functional, physical, psychological, social, and vocational goals must include: a medical director, pain team physician(s), who should preferably be board certified in an appropriate specialty, and a pain team psychologist. Professionals from other disciplines on the team may include, but are not limited to: a biofeedback therapist, an occupational therapist, a physical therapist, a registered nurse (RN), a case manager, an exercise physiologist, a psychologist, a psychiatrist, and/or a nutritionist.

- ❖ Time to Produce Effect: 3 to 4 weeks.
- ❖ Frequency: Full time programs – No less than 5 hours per day, 5 days per week; part-time programs – 4 hours per day, 2–3 days per week.
- ❖ Optimum Duration: 3 to 12 weeks at least 2–3 times a week. Follow-up visits weekly or every other week during the first 1 to 2 months after the initial program is completed.
- ❖ Maximum Duration: 4 months for full-time programs and up to 6 months for part-time programs. Periodic review and monitoring thereafter for 1 year, and additional follow-up based on the documented maintenance of functional gains.

- ii. Occupational Rehabilitation: This is a formal interdisciplinary program addressing a patient's employability and return to work. It includes a progressive increase in the number of hours per day in which a patient completes work simulation tasks until the patient can tolerate a full work day. A full work day is case specific and is defined by the previous employment of the patient. Safe workplace practices and education of the employer and family and/or social support system regarding the person's status should be included. This is accomplished by addressing the medical, psychological, behavioral, physical, functional, and vocational components of employability and return to work.

There is some evidence that an integrated care program, consisting of workplace interventions and graded activity teaching that pain need not limit activity, is effective in returning patients with chronic low back pain to work, even with minimal reported reduction of pain ([Lambeek](#)

[et al., 2010](#)). The occupational medicine rehabilitation interdisciplinary team should, at a minimum, be comprised of a qualified medical director who is board certified with documented training in occupational rehabilitation; team physicians having experience in occupational rehabilitation; an occupational therapist; and a physical therapist.

As appropriate, the team may also include any of the following: chiropractor, an RN, a case manager, a psychologist, a vocational specialist, or a certified biofeedback therapist.

- ❖ Time to Produce Effect: 2 weeks.
- ❖ Frequency: 2 to 5 visits per week, up to 8 hours per day.
- ❖ Optimum Duration: 2 to 4 weeks.
- ❖ Maximum Duration: 6 weeks. Participation in a program beyond 6 weeks must be documented with respect to need and the ability to facilitate positive symptomatic and functional gains.

iii. Opioid/Chemical Treatment Programs: Refer to the Division's Chronic Pain Disorder Medical Treatment Guidelines.

b. **Informal Interdisciplinary Rehabilitation Program**: A coordinated interdisciplinary pain rehabilitation program is one in which the authorized treating physician coordinates all aspects of care. This type of program is similar to the formal programs in that it is goal-oriented and provides interdisciplinary rehabilitation services to manage the needs of the patient in the following areas: (a) functional, (b) medical, (c) physical, (d) psychological, (e) social, and (f) vocational.

This program is different from a formal program in that it involves lower frequency and intensity of services/treatment. Informal rehabilitation is geared toward those patients who do not need the intensity of service offered in a formal program or who cannot attend an all-day program due to employment, daycare, language, or other barriers.

Patients should be referred to professionals experienced in outpatient treatment of chronic pain. The Division recommends the authorized treating physician consult with physicians experienced in the treatment of chronic pain to develop the plan of care. Communication among care providers regarding clear objective goals and progress toward the goals is essential. Employers

should be involved in return to work and work restrictions. The family and/or social support system should be included in the treatment plan. Professionals from other disciplines likely to be involved include: a biofeedback therapist, an occupational therapist, a physical therapist, an RN, a psychologist, a case manager, an exercise physiologist, a psychiatrist, and/or a nutritionist.

- ❖ Time to Produce Effect: 3 to 4 weeks.
- ❖ Frequency: Full-time programs – No less than 5 hours per day, 5 days per week; Part-time programs – 4 hours per day for 2–3 days per week.
- ❖ Optimum Duration: 3 to 12 weeks at least 2–3 times a week. Follow-up visits weekly or every other week during the first 1 to 2 months after the initial program is completed.
- ❖ Maximum Duration: 4 months for full-time programs and up to 6 months for part-time programs. Periodic review and monitoring thereafter for 1 year, and additional follow-up based upon the documented maintenance of functional gains.

## 6. JOB SITE ALTERATION

### **General Principles of Job Site Alteration**

There is no single factor or combination of factors that is proven to prevent or ameliorate cumulative trauma conditions, but a combination of ergonomic and psychosocial factors are generally considered to be important. Ergonomic factors that may be considered include use of force, repetition, awkward positions, upper extremity vibration, cold environment, and contact pressure on the nerve. Psychosocial factors to be considered include pacing, degree of control over job duties, perception of job stress, and supervisory support.

All job site evaluations should include suggested ergonomic changes as applicable. It is inappropriate to limit a job site evaluation to a strict isolated evaluation of causation risk factors only.

Job evaluation and modification should include input from a licensed health care professional with training in ergonomics or a certified ergonomist; the employee; and the employer. The employee must be observed performing relevant job functions in order for the job site evaluation to be a valid representation of a typical workday. If the employee is unable to perform the job function for observation, a co-worker in an identical job position may be observed instead. Periodic follow-up is recommended to

assess the effectiveness of the intervention and need for additional ergonomic changes.

Because ergonomic changes are a required medical treatment for cumulative trauma conditions and the person performing the evaluations is a health care professional, it is assumed the insurer will pay for the job site evaluation.

- a. **Interventions:** There are no conclusive studies with convincing evidence of standard ergonomic changes that will accommodate all workers. Individual characteristics, such as height or strength, affect the ideal organization of the workstation. The worksite should be adjusted to support neutral, yet natural, positions. In addition, workers should be counseled to vary tasks throughout the day whenever possible. OSHA suggests that workers who perform repetitive tasks, including keyboarding, change activities over a 5-minute interval every hour. Mini-breaks may include stretching exercises. The following should be considered: engineering controls, e.g., mechanizing the task, and changing the tool used, or adjusting the job site; or administrative controls, e.g., adjusting the time an individual performs the task.

REFERENCED

- b. **Seating Description:** The following description may aid in evaluating seated work positions: The head should be in a neutral position, and if a monitor is used, there should be at least 18 inches of viewing distance with no glare. Arms should rest naturally, with the elbow at the side and flexed to 90 degrees or slightly extended. Some individuals may prefer a wrist pad to reduce wrist extension. Wrists should be straight or minimally extended. It is generally preferable to avoid dependence on arm rests. The back must be properly supported by a chair with the back upright or leaning backwards slightly, allowing change in position with backrest adjustment. There should be good knee and legroom, with the feet resting comfortably on the floor or footrest. Tools should be within easy reach, and twisting or bending should be avoided ([California / Occupational Safety & Health Administration Cal/OSHA, 1999](#); [McAtamney & Nigel Corlett, 1993](#)).
- c. **Job Hazard Checklist:** The following table entitled, "Ergonomic Considerations," is adopted with modification from Washington State's job hazard checklist. This table is a generally accepted guide for identifying job duties which may pose ergonomic hazards. The fact that an ergonomic hazard exists at a specific job, or is suggested in the table, does not establish a causal relationship between a job and a musculoskeletal injury. However, when an individual has a work-related injury and ergonomic hazards exist that affect the injury, appropriate job modifications should be made. Proper correction of hazards may prevent future injuries to others, as well as aid in the recovery of the injured worker.
- d. **Tools:** The tools should be assessed for the individual and not used universally. It is important to select the right tool for the task. In general, the person should work in the most neutral position possible and use the least force possible. For force tools, the grip should not span more than 3.5 inches, and the handle diameter should not be greater than 2 inches. Precision tools may require a smaller diameter ([National Institute of Occupational Safety and Health \[NIOSH\], 1997](#)). If possible, highly repetitive forearm tasks requiring manual supination/pronation should be avoided by using power tools.

**SEE NEXT PAGE FOR ERGONOMIC CONSIDERATIONS TABLE**

e. Ergonomic Considerations Table: \*

Type of Job Duty	Hours per Day
<p><u>Pinching</u> an unsupported object(s) weighing 2 lbs or more per hand, or pinching with a force of 4 lbs or more per hand (comparable to pinching a half-ream of paper):</p>	<p>More than 3 hours total/day</p>
<p>1. Highly repetitive motion.</p>	
<p>2. Wrist palmar flexion greater than 45 degrees, wrist extension greater than 30 degrees, ulnar deviation greater than 20 degrees, or radial deviation greater than 20 degrees.</p>	
<p>3. Most of the work cycle performed with the elbow flexed equal to or greater than 90 degrees.</p>	
<p>4. No other risk factors.</p>	<p>More than 4 hours total/day</p>
<p><u>Gripping</u> (an) unsupported object(s) weighing 10 lbs or more/hand, or gripping with a force of 10 lbs or more/hand (comparable to clamping light duty automotive jumper cables onto a batter): *Handles should be rounded and soft, with at least 1.25"-2.0" in diameter grips at least 5" long. Preferably, a power grip should be used (<a href="#">Occupational Safety &amp; Health Service (OSHA), 1988</a>).</p>	<p>More than 3 hours total/day</p>
<p>1. Highly repetitive motion.</p>	
<p>2. Wrist palmar flexion greater than 45 degrees, wrist extension greater than 30 degrees, ulnar deviation greater than 20 degrees, or radial deviation greater than 20 degrees.</p>	
<p>3. Most of the work cycle performed with the elbow flexed equal to or greater than 90 degrees.</p>	
<p>No other risk factors.</p>	<p>More than 4 hours total/day</p>

<u>Repetitive Motion</u> (using the same motion with little or no variation) with a cycle time 30 seconds or less or greater than 50% of cycle time performing the same task:	
1. High, forceful exertions with the hands, with wrist palmar flexion greater than 45 degrees, wrist extension greater than 30 degrees, ulnar deviation greater than 20 degrees, or radial deviation greater than 20 degrees ( <a href="#">Keir, Bach, Hudes, &amp; Rempel, 2007</a> ; <a href="#">Rempel, Keir, &amp; Bach, 2008</a> ).	More than 2 hours total/day
2. Most of the work cycle performed with the elbow flexed equal to or greater than 90 degrees.	
3. No other risk factors.	More than 6 hours total/day
<u>Intensive Keying</u> :	
1. Wrist palmar flexion greater than 45 degrees, wrist extension greater than 30 degrees, ulnar deviation greater than 20 degrees, or radial deviation greater than 20 degrees.	More than 4 hours total/day
2. Most of the work cycle performed with the elbow flexed equal to or greater than 90 degrees.	
3. No other risk factors.	More than 7 hours total/day
<u>Repeated Impact</u> :	
1. Using the hand (heel/base of palm) as a hammer more than once per minute.	More than 2 hours total/day
<u>Vibration</u> : Two determinants of the tolerability of segmental vibration of the hand are the frequency and the acceleration of the motion of the vibrating tool, with lower frequencies being more poorly tolerated at a given level of imposed acceleration, expressed below in multiples of the acceleration due to gravity.	
1. Frequency range 8-15 Hz and acceleration 6 g	More than 30 minutes at a time
2. Frequency range 80 Hz and acceleration 40 g	



3. Frequency range 250 Hz and acceleration 250 g	
Vibration, continued:	
4. Frequency range 8-15 Hz and acceleration 1.5 g	More than 4 hours at a time
5. Frequency range 80 Hz and acceleration 6 g	
6. Frequency range 250 Hz and acceleration 20 g	

\* This table may not be used to establish causation. Refer to Section D.3 Medical Causation for Cumulative Trauma Conditions. Recommendations for ergonomic changes to make the workplace more comfortable and efficient for the worker are not identical to risk factors which may cause an identified cumulative trauma condition.

REFERENCED VERSION

7. **MEDICATIONS AND MEDICAL MANAGEMENT** Use of medications in the treatment of cumulative trauma related conditions is generally accepted for controlling acute pain and inflammation. Use of medications will vary widely due to the spectrum of injuries from simple strains to post-surgical analgesia. A thorough medication history, including use of alternative and over-the-counter medications, should be performed at the time of the initial visit and updated periodically. Treatment for pain control is initially accomplished with acetaminophen and/or NSAIDs. The patient should be educated regarding the interaction with prescription and over the counter medications as well as the contents of over the counter herbal products.

Oral non-steroidal anti-inflammatory drugs (NSAIDs) and acetaminophen are useful in treating conditions associated with degenerative joint disease and/or inflammation. Topical medications may also be useful in controlling pain.

- a. **Acetaminophen:** an effective analgesic with anti-pyretic but not anti-inflammatory activity. Acetaminophen is generally well-tolerated, causes little or no gastrointestinal (GI) irritation, and is not associated with ulcer formation. Acetaminophen has been associated with liver toxicity in overdose situations or in chronic alcohol use. Patients may not realize that many over-the-counter preparations contain acetaminophen. The total daily dose of acetaminophen is recommended not to exceed three grams per 24-hour period, from all sources, including narcotic-acetaminophen combination preparations.

There is good evidence that acetaminophen is not more effective than placebo for the treatment of knee osteoarthritis ([Bannuru et al., 2015](#)). Thus, it may not be useful for upper extremity osteoarthritis. It may be used on patients with contraindications to other medications.

- ❖ Optimum Duration: 7 to 10 days.
- ❖ Maximum Duration: Long-term use as indicated on a case-by-case basis. Use of this substance long-term (for 3 days per week or greater) may be associated with rebound pain upon cessation.

- b. **Minor Tranquilizer/Muscle Relaxants:** They are generally **not recommended** for use in patients with cumulative trauma conditions and, if used, should not exceed 2 weeks total.
- c. **Nonsteroidal Anti-Inflammatory Drugs (NSAIDs):** useful for pain and inflammation. In mild cases, they may be the only drugs required for analgesia. There are several classes of NSAIDs. The response of the individual injured worker to a specific medication is unpredictable. For this reason, a range of NSAIDs may be tried in each case, with the most effective preparation being continued. Patients should be closely monitored for adverse reactions. The FDA advises that many NSAIDs may cause an increased risk of serious cardiovascular thrombotic events, myocardial infarction, and stroke, which can be fatal. Administration of proton pump inhibitors, Histamine 2 Blockers or prostaglandin analog misoprostol along with these NSAIDs may reduce the risk of duodenal and gastric ulceration, in patients at higher risk for this adverse event (e.g., age > 60, concurrent antiplatelet or corticosteroid therapy). They do not impact possible cardiovascular complications ([Hooper et al., 2004](#)). Due to the cross-reactivity between aspirin and NSAIDs, NSAIDs should not be used in aspirin-sensitive patients, and it should be used with caution in all asthma patients. NSAIDs are associated with abnormal renal function, including renal failure, as well as abnormal liver function. Patients with renal or hepatic disease may need increased dosing intervals with chronic use. Chronic use of NSAIDs is **generally not recommended** due to increased risk of cardiovascular events and GI bleeding.

Topical NSAIDs may be more appropriate for some patients as there is some evidence they are associated with fewer systemic adverse events than oral NSAIDs ([Derry, Moore, Gaskell, McIntyre, & Wiffen, 2015](#); [Massey, Derry, Moore, & McQuay, 2010](#)).

NSAIDs may be associated with non-unions; thus, their use with fractures is questionable ([Jeffcoach et al., 2014](#)).

Certain NSAIDs may have interactions with various other medications. Individuals may have adverse events not listed above. Intervals for metabolic screening are dependent on the patient's age and general health status and should be within parameters listed for each specific medication. Complete Blood Count (CBC) and liver and renal function should be monitored at least every six months in patients on chronic NSAIDs and initially when indicated.

- i. **Non-Selective Non-Steroidal Anti-Inflammatory Drugs:** includes NSAIDs and acetylsalicylic acid. Serious GI toxicity, such as bleeding, perforation, and ulceration can occur at any time, with or without warning symptoms, in patients treated with traditional NSAIDs. Physicians should inform patients about the signs and/or symptoms of

serious GI toxicity and what steps to take if they occur. Anaphylactoid reactions may occur in patients taking NSAIDs. NSAIDs may interfere with platelet function. Fluid retention and edema have been observed in some patients taking NSAIDs.

- ❖ Optimal Duration: 1 week.
- ❖ Maximum duration: 1 year. Use of these substances long-term (3 days per week or greater) is associated with rebound pain upon cessation.

- ii Selective Cyclo-oxygenase-2 (COX-2) Inhibitors: COX-2 inhibitors differ from the traditional NSAIDs in adverse side effect profiles. The major advantages of selective COX-2 inhibitors over traditional NSAIDs are that they have less GI toxicity and no platelet effects. COX-2 inhibitors can worsen renal function in patients with renal insufficiency; thus, renal function may need monitoring.

COX-2 inhibitors should not be first-line for low risk patients who will be using an NSAID short-term. COX-2 inhibitors are indicated in select patients who do not tolerate traditional NSAIDs. Serious upper GI adverse events can occur even in asymptomatic patients. Patients at high risk for GI bleeding include those who use alcohol, smoke, are older than 65, take corticosteroids or anti-coagulants, or have a longer duration of therapy. Celecoxib is contraindicated in sulfonamide allergic patients.

- ❖ Optimal Duration: 7 to 10 days.
- ❖ Maximum Duration: Chronic use is appropriate in individual cases. Use of these substances long-term (3 days per week or greater) is associated with rebound pain upon cessation.

- d. Opioids: should be primarily reserved for the treatment of severe upper extremity pain. There are circumstances where prolonged use of opioids is justified based upon specific diagnosis and in pre- and post-operative patients. In these and other cases, it should be documented and justified. In mild-to-moderate cases of upper extremity pain, opioid medication should be used cautiously on a case-by-case basis. Adverse effects include respiratory depression, the development of physical and psychological dependence, and impaired alertness.

Opioids medications should be prescribed with strict time, quantity, and duration guidelines, and with definitive cessation parameters. Pain is subjective in nature and should be evaluated using a pain scale and

assessment of function to rate effectiveness of the opioid prescribed. It is recommended that the provider access the Colorado Prescription Drug Monitoring Program (PDMP) before prescribing opioids. The PDMP allows the prescribing physician to see most of the controlled substances prescribed by other physicians for an individual patient. Any use beyond the maximum should be documented and justified based on the diagnosis and/or invasive procedures.

- ❖ Optimum Duration: Usually 3-5 days post-operatively
- ❖ Maximum Duration: 2 weeks. Use beyond 2 weeks is acceptable in appropriate cases when functional improvement is documented. Refer to the Division's Chronic Pain Disorder Medical Treatment Guidelines, which give a detailed discussion regarding medication use in chronic pain management. Use beyond 30 days after non-traumatic injuries, or 6 weeks post-operatively is **not recommended**. If longer treatment is justified, the physician should access the Colorado Prescription Drug Monitoring Program (PDMP) and follow recommendations in the Chronic Pain Guideline.

- e. **Psychotropic/Anti-anxiety/Hypnotic Agents:** may be useful for treatment of mild and chronic pain, dysesthesias, sleep disorders, and depression. Post-operative patients may receive medication to assure normal sleep cycles. Antidepressant medications, such as tricyclics and Selective Serotonin Reuptake Inhibitors (SSRIs), are useful for affective disorder and chronic pain management. Tricyclic anti-depressant agents, in low dose, are useful for chronic pain but have more frequent side effects.

Anti-anxiety medications are best used for short-term treatment (i.e., less than 6 months). Accompanying sleep disorders are best treated with sedating antidepressants prior to bedtime. Frequently, combinations of the above agents are useful. As a general rule, physicians should assess the patient's prior history of substance abuse or depression prior to prescribing any of these agents.

Due to the habit-forming potential of the benzodiazepines and other drugs found in this class, they are **not generally recommended**. Refer to the Chronic Pain Guidelines which give a detailed discussion regarding medication use in chronic pain management.

- ❖ Optimal Duration: 1 to 6 months.
- ❖ Maximum Duration: 6 to 12 months, with monitoring.

- f. **Smoking Cessation Medications and Treatment:** Tobacco dependence is chronic and may require repeated attempts to quit. All smoking cessation programs should be accompanied by behavioral support which may include practical counseling sessions, social support, and telephone follow up. A variety of medications have been used, including Bupropion SR, nicotine patches, gum, inhaler, lozenges or nasal spray, and varenicline. When nicotine supplements are used, cotinine testing will be positive. Urine anabasine or exhaled carbon monoxide 5 ppm or less may be used to check tobacco abstinence ("[Treating tobacco use and dependence: 2008 update U.S. Public Health Service Clinical Practice Guideline executive summary, 2008](#)").

There is some evidence that among adults motivated to quit smoking, 12 weeks of open-label treatment including counseling and one of the following: nicotine patch, varenicline, or combination nicotine replacement therapy (nicotine patch and nicotine lozenge) are equally effective in assisting motivated smokers to quit smoking over a period of one year ([T. B. Baker et al., 2016](#)).

There is some evidence that among adults motivated to quit smoking, abrupt smoking cessation is more effective than gradual cessation for abstinence lasting over a period of 4 weeks to 6 months, even for smokers who initially prefer to quit by gradual reduction ([Lindson-Hawley et al., 2016](#)).

- g. **Topical Drug Delivery:** Creams and patches may be an alternative treatment of localized musculoskeletal disorders.

It is necessary that all topical agents be used with strict instructions for application as well as the maximum number of applications per day to obtain the desired benefit and avoid potential toxicity. As with all medications, patient selection must be rigorous to select those patients with the highest probability of compliance. Refer to Section H.14.c Iontophoresis in Therapy-Passive for information regarding topical iontophoretic agents.

- i. **Topical Salicylates and Nonsalicylates:** have been shown to be effective in relieving pain in acute and chronic musculoskeletal conditions. Topical salicylate and nonsalicylates achieve tissue levels that are potentially therapeutic, at least with regard to COX inhibition.
- ii. There is good evidence that diclofenac gel reduces pain and improves function in mild-to-moderate hand osteoarthritis ([Altman et al., 2009](#)). There is some evidence that topical ketoprofen patches are more effective than placebo in reducing pain of upper extremity tendonitis. However, the need for continuous skin application may limit overall use ([Mazieres et al., 2005](#)). Use of ketoprofen topical patch for the

disorders described in these guidelines has not been FDA approved at the time of this guideline writing.

- iii. Other than local skin reactions, the side effects of therapy exist but are minimal. The usual contraindications to use of these compounds need to be considered. Local skin reactions are rare and systemic effects are even less common. Their use in patients receiving warfarin therapy may result in alterations in bleeding time. Overall, the low level of systemic absorption can be advantageous, allowing topical use of these medications when systemic administration is relatively contraindicated. Examples include patients with hypertension, cardiac failure, or renal insufficiency. Hepatic changes have been documented with topical NSAID use and therefore monitoring of liver enzymes is recommended.

- ❖ Optimal Duration: 1 week.
- ❖ Maximal Duration: 2 weeks per episode.

- iv. Capsaicin: is another medication option for topical drug use in upper extremity injury. Capsaicin offers a safe and effective alternative to systemic NSAID therapy. Although it is quite safe, effective use of capsaicin is limited by the local stinging or burning sensation that typically dissipates with regular use, usually after the first 7 to 10 days of treatment. Patients should be advised to apply the cream on the affected area with a plastic glove or cotton applicator and to avoid inadvertent contact with eyes and mucous membranes.

- ❖ Optimal Duration: 1 week.
- ❖ Maximal Duration: 2 weeks per episode.

- v. Iontophoretic Agents: Refer to Section H.14.c Iontophoresis in Therapy-Passive.

- vi. Topical Glyceryl Trinitrate: There is some evidence from a small study that wearing a topical patch containing glyceryl trinitrate over an area of tendinopathy is more effective than a placebo patch in reducing pain and improving overall clinical recovery in subjects with lateral epicondylitis over a period of 6 months ([Ozden et al., 2014](#)). Improvement in function was not clearly demonstrated. There is some evidence that topical glyceryl trinitrate is not effective for epicondylitis from a study demonstrating no benefit compared to placebo with varied doses ([Paoloni et al., 2009](#)). Side effects include headaches.

The patch must be applied every day. Therefore it is **not generally recommended** and may only be used if there is failure of other conservative care at 8-12 weeks.

❖ Time to effect: 3 weeks

vii. Topical Lidocaine: There is no evidence that lidocaine patches have a functional benefit over other well-accepted treatment for carpal tunnel ([Nalamachu, Crockett, Gammaitoni, & Gould, 2006](#); [Nalamachu, Crockett, & Mathur, 2006](#)). At the time of this writing, post-herpetic neuralgia is the only medical condition for which topical lidocaine patch is FDA approved (Food and Drug Administration). The patches are **not generally recommended**, although may be used when the primary complaint of the patient is pain and the patient refuses a steroid injection.

h. Glucosamine and chondroitin: are sold in the United States as dietary supplements. Their dosage, manufacture, and purity are not regulated by the Food and Drug Administration. Pharmaceutical grade versions are not available in the United States and thus, these medications are **not recommended**.

i. Vitamin B6: Randomized trials on non-surgical treatment for carpal tunnel syndrome have demonstrated conflicting results. Higher doses may result in development of a toxic peripheral neuropathy. In the absence of definitive literature showing a beneficial effect, use of Vitamin B6 cannot be recommended ([Ashworth, 2010](#); [O'Connor et al., 2003](#)).

## 8. NON-INTERDISCIPLINARY OCCUPATIONAL REHABILITATION PROGRAMS

These generally-accepted programs are work-related, outcome focused, individualized treatment programs. Objectives of the programs include, but are not limited to, improvement of cardiopulmonary and neuromusculoskeletal functions (strength, endurance, movement, flexibility, stability, and motor control functions), patient education, and symptom relief. The goal is for patients to gain full- or optimal-function and return to work. The service may include the time limited use of passive modalities with progression to achieve treatment and/or simulated/real work.



a. **Work conditioning:** is usually initiated once re-conditioning has been completed but may be offered at any time throughout the recovery phase. It should be initiated when imminent return of a patient to modified or full-duty is not an option, but the prognosis for returning the patient to work at completion of the program is at least fair to good.

- ❖ Length of Visit: 1 to 2 hours per day.
- ❖ Frequency: 2 to 5 visits per week.
- ❖ Optimum Duration: 2 to 4 weeks.
- ❖ Maximum Duration: 6 weeks. Participation in a program beyond 6 weeks must be documented with respect to need and the ability to facilitate positive symptomatic or functional gains.

b. **Work simulation:** is a program where an individual completes specific work-related tasks for a particular job and return-to-work. Use of this program is appropriate when modified duty can only be partially accommodated in the workplace, when modified duty in the workplace is unavailable, or when the patient requires more structured supervision. The need for workplace simulation should be based upon the results of a Functional Capacity Evaluation (FCE) and/or job site Evaluation.

- ❖ Length of Visit: 2 to 6 hours per day.
- ❖ Frequency: 2 to 5 visits per week.
- ❖ Optimum Duration: 2 to 4 weeks.
- ❖ Maximum Duration: 6 weeks. Participation in a program beyond 6 weeks must be documented with respect to need and the ability to facilitate positive symptomatic or functional gains.

## 9. **PERSONALITY/PSYCHOSOCIAL/PSYCHOLOGICAL INTERVENTION**

Psychosocial treatment is a well-established therapeutic and diagnostic intervention with selected use in acute pain patients and more widespread use in sub-acute and chronic pain populations. Psychosocial treatment is recommended as an important component in the total management of a patient with chronic pain and should be implemented as soon as the problem is identified.

Several studies have noted lack of a direct connection between impairment and disability. It appears that the lack of connection is due to differences among individuals in level of depression, coping strategies, or other psychological distress ([Caffee, Chu,](#)

[Sorensen, Martens, & Elfar, 2015](#); [Farzad et al., 2015](#); [Kortlever, Janssen, van Berckel, Ring, & Vranceanu, 2015](#)).

If a diagnosis consistent with the standards of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM) has been determined, the patient should be evaluated for the potential need for psychiatric medications. The authorized treating physician or the consulting psychiatrist may order the use of any medication to treat a diagnosed condition. Visits for management of psychiatric medications are medical in nature and are not a component of psychosocial treatment. Therefore, separate visits for medication management may be necessary, depending on the patient and medications selected.

Psychosocial interventions include psychotherapeutic treatments for mental health conditions as well as behavioral medicine treatments. These interventions may similarly be beneficial for patients without psychiatric conditions but who may need to make major life changes to cope with pain or adjust to disability. Examples of these treatments include cognitive behavioral therapy (CBT), relaxation training, mindfulness training, and sleep hygiene training.

The screening or diagnostic workup should clarify and distinguish between pre-existing, aggravated, and/or purely causative psychological conditions. Therapeutic and diagnostic modalities include, but are not limited to, individual counseling and group therapy. Treatment can occur within an individualized model, a multi-disciplinary model, or a structured pain management program.

A psychologist with a PhD, PsyD, or EdD credentials or a psychiatric MD/DO may perform psychosocial treatments. The following professionals may also treat in consultation with a psychologist with a PhD, PsyD, or EdD or a psychiatric MD/DO: other licensed mental health providers; licensed health care providers with training in CBT; or licensed and certified CBT therapists who have experience in treating chronic pain disorders in injured workers.

CBT is a group of psychological therapies that are sometimes referred to by more specific names such as Rational Emotive Behavior Therapy, Rational Behavior Therapy, Rational Living Therapy, Cognitive Therapy, and Dialectic Behavior Therapy. Variations of CBT methods can be used to treat a variety of conditions, including chronic pain, depression, anxiety, phobias, and post-traumatic stress disorder (PTSD). For patients with multiple diagnoses, more than one type of CBT might be needed. The CBT used in research studies is often "manualized CBT," meaning that the treatment follows a specific protocol in a manual ([Thorn, 2004](#)). In clinical settings, CBT may involve the use of standardized materials, but it is also commonly adapted by a psychologist or psychiatrist to the patient's unique circumstances. If the CBT is being performed by a non-mental health professional, a manual approach would be strongly recommended. CBT must be distinguished from neuropsychological therapies

used to teach compensatory strategies to brain injured patients, which are also called “cognitive therapy.”

It should be noted that most clinical trials on CBT exclude subjects who have significant psychiatric diagnoses. Consequently, the selection of patients for CBT should include the following considerations. CBT is instructive and structured, using an educational model with homework to teach inductive rational thinking. Because of this educational model, a certain level of literacy is assumed for most CBT protocols. Patients who lack the cognitive and educational abilities required by a CBT protocol are unlikely to be successful. Further, given the highly structured nature of CBT, it is more effective when a patient’s circumstances are relatively stable. For example, if a patient is about to be evicted, is actively suicidal, or is coming to sessions intoxicated, these matters will generally preempt CBT treatment for pain, and require other types of psychotherapeutic response. Conversely, literate patients whose circumstances are relatively stable, but who catastrophize or cope poorly with pain or disability are often good candidates for CBT for pain. Similarly, literate patients whose circumstances are relatively stable, but who exhibit unfounded medical phobias, are often good candidates for CBT for anxiety.

There is good evidence that cognitive intervention reduces low back disability in the short-term and in the long-term. In one of the studies, the therapy consisted of 6, 2-hour sessions given weekly to workers who had been sick-listed for 8-12 weeks. Comparison groups include those who received routine care ([Linton, Boersma, Jansson, Svard, & Botvalde, 2005](#); [Storheim, Brox, Holm, Koller, & Bo, 2003](#)). There is good evidence that psychological interventions, especially CBT, are superior to no psychological intervention for chronic low back pain ([Hoffman et al., 2007](#)). There is also good evidence that self-regulatory interventions, such as biofeedback and relaxation training, may be equally effective ([Hoffman et al., 2007](#)). There is good evidence that six group therapy sessions lasting one and a half hours each focused on CBT skills improved function and alleviated pain in uncomplicated sub-acute and chronic low back pain patients ([Lamb et al., 2010](#)). There is some evidence that CBT provided in 7, 2-hour small group sessions can reduce the severity of insomnia in chronic pain patients ([Currie, Wilson, Pontefract, & deLaplante, 2000](#)). A Cochrane meta-analysis grouped very heterogeneous behavioral interventions and concluded that there was good evidence that CBT may reduce pain and disability, but the effect size was uncertain ([Cochrane] [Eccleston, Williams, & Morley, 2009](#)). In total, the evidence clearly supports CBT, and it should be offered to all chronic pain patients who do not have other serious issues, as discussed above.

CBT is often combined with active therapy in an interdisciplinary program, whether formal or informal. It must be coordinated with a psychologist or psychiatrist. CBT can be done in a small group or individually, and the usual number of treatments varies between 8 and 16 sessions.

Before CBT is done, the patient must have a full psychological evaluation. The CBT program must be done under the supervision of a psychologist with a PhD, PsyD, EdD, or psychiatric MD/DO.

Psychological Diagnostic and Statistical Manual of Mental Disorders (DSM) disorders are common in chronic pain. One study demonstrated that the majority of patients who had failed other therapy and participated in an active therapy program also suffered from major depression. However, in a program that included CBT and other psychological counseling, the success rate for return to work was similar for those with and without a DSM diagnosis. This study further strengthens the argument for having some psychological intervention included in all chronic pain treatment plans ([Gatchel, Polatin, Mayer, & Garcy, 1994](#)).

For all psychological/psychiatric interventions, an assessment and treatment plan with measurable behavioral goals, time frames, and specific interventions must be provided to the treating physician prior to initiating treatment. A status report must be provided to the authorized treating physician every two weeks during initial more frequent treatment and monthly thereafter. The report should provide documentation of progress toward functional recovery and a discussion of the psychosocial issues affecting the patient's ability to participate in treatment. The report should also address pertinent issues such as pre-existing, aggravated, and/or causative issues, as well as realistic functional prognosis.

**a. Cognitive Behavioral Therapy (CBT) or Similar Treatment:**

- ❖ Time to Produce Effect: 6 to 8 1–2 hour sessions, group or individual (1-hour individual or 2-hour group).
- ❖ Maximum Duration: 16 sessions.

NOTE: Before CBT is done, the patient must have a full psychological evaluation. The CBT program must be done under the supervision of a psychologist with a PhD, PsyD, or EdD or a Psychiatric MD/DO.

**b. Other Psychological/Psychiatric Interventions:**

- ❖ Time to Produce Effect: 6 to 8 weeks.
- ❖ Frequency: 1 to 2 times weekly for the first 2 weeks (excluding hospitalization, if required), decreasing to 1 time per week for the second month. Thereafter, 2 to 4 times monthly with the exception of exacerbations, which may require increased frequency of visits. Not to include visits for medication management

- ❖ Optimum Duration: 2 to 6 months.
- ❖ Maximum Duration: 6 months. Not to include visits for medication management. For select patients, longer supervised psychological/psychiatric treatment may be required, especially if there are ongoing medical procedures or complications. If counseling beyond 6 months is indicated, the management of psychosocial risks or functional progress must be documented. Treatment plan/progress must show severity.

#### **10. RESTRICTION OF ACTIVITIES**

Continuation of normal daily activities is the recommendation for most patients, since immobility will negatively affect rehabilitation. Prolonged immobility results in a wide range of deleterious effects, such as a reduction in aerobic capacity and conditioning, loss of muscle strength and flexibility, increased segmental stiffness, promotion of bone demineralization, impaired disc nutrition, and the facilitation of the illness role.

Some level of immobility may occasionally be appropriate, including splinting/casting. While these interventions may be occasionally ordered in the acute phase, the provider should be aware of their impact on the patient's ability to adequately comply with and successfully complete rehabilitation. Activity should be increased based on the improvement of core strengthening.

Patients should be educated regarding the detrimental effects of immobility versus the efficacious use of limited rest periods. Adequate rest allows the patient to comply with active treatment and benefit from the rehabilitation program. In addition, complete work cessation should be avoided, if possible, since it often further aggravates the pain presentation and promotes disability. Modified return to work is almost always more efficacious and rarely contraindicated in the vast majority of injured workers.

#### **11. RETURN-TO-WORK**

Return to work and/or work-related activities, whenever possible, is one of the major components in treatment and rehabilitation. Return to work should be addressed by each workers' compensation provider at the first meeting with the injured employee and updated at each additional visit. A return-to-work format should be part of a company's health plan, knowing that return to work can decrease anxiety, reduce the possibility of depression, and reconnect the worker with society.

Because a prolonged period of time off work will decrease the likelihood of return to work, the first weeks of treatment are crucial in preventing and/or reversing chronicity and disability mindset. In complex cases, experienced nurse case managers may be required to assist in return to work. Other services, including psychological evaluation and/or treatment, job site analysis, and vocational assistance, may be employed.

Two counseling sessions with an occupational physician, and work site visit if necessary, may be helpful for workers who are concerned about returning to work ([Jensen, Jensen, & Nielsen, 2012](#)).

At least one study suggests that health status is worse for those patients who do not return to work than those who do. Self-employment and injury severity predict return to work. Difficulty with pain control, ADLs, and anxiety and depression were common ([Kendrick et al., 2012](#)).

The following should be considered when attempting to return an injured worker with chronic pain to work.

- a. **Job History Interview:** The authorized treating physician should perform a job history interview at the time of the initial evaluation and before any plan of treatment is established. Documentation should include the worker's job demands, stressors, duties of current job, and duties of job at the time of the initial injury. In addition, cognitive and social issues should be identified, and treatment of these issues should be incorporated into the plan of care.
- b. **Coordination of Care:** Management of the case is a significant part of return to work and may be the responsibility of the authorized treating physician, occupational health nurse, risk manager, or others. Case management is a method of communication between the primary provider, referral providers, insurer, employer, and employee. Because case management may be coordinated by a variety of professionals, the case manager should be identified in the medical record.
- c. **Communication:** This is essential between the patient, authorized treating physician, employer, and insurer. Employers should be contacted to verify employment status, job duties and demands, and policies regarding injured workers. In addition, the availability and duration of temporary and permanent restrictions, as well as other placement options, should be discussed and documented. All communications in the absence of the patient are required to be documented and made available to the patient.

- d. **Establishment of Return-to-Work Status:** Return to work for persons with chronic pain should be considered therapeutic, assuming that work is not likely to aggravate the basic problem or increase the discomfort. In **some** cases of chronic pain, the worker may not be currently working or even employed. The goal of return to work would be to return the worker to any level of employment with the current employer or to return him/her to any type of new employment. Temporary restrictions may be needed while recommended ergonomic or adaptive equipment is obtained; employers should obtain recommended equipment in a timely manner.
- e. **Establishment of Activity Level Restrictions:** A formal job description for the injured worker is necessary to identify physical demands at work and assist in the creation of modified duty. A job site evaluation may be utilized to identify applicable tasks such as pushing, pulling, lifting, reaching, grasping, pinching, sitting, standing, posture, and ambulatory distance and terrain. If applicable, a job site evaluation may also be utilized to assess temperature, air flow, noise, and the number of hours worked per day in a specific environment. Also refer to Section H.6 Job Site Alterations. Because exacerbation of symptoms affecting function is unpredictable, an extended, occupationally focused functional capacity evaluation may be necessary to determine the patient's tolerance for job type tasks over a continued period of time. Job requirements should be reviewed for the entire 8 hours or more of the working day. Between one and three days after the evaluation, there should be a follow-up evaluation by the treating therapist and/or the authorized treating physician to assess the patient's status. When prescribing the functional capacity evaluation, the physician must assess the probability of return to work against the potential for exacerbation of the work related condition. Work restrictions assigned by the authorized treating physician may be temporary or permanent. The case manager should continue to seek out modified work until restrictions become less cumbersome or as the worker's condition improves or deteriorates.
- f. **Rehabilitation and Return to Work:** As part of rehabilitation, every attempt should be made to simulate work activities so that the authorized treating physician may promote adequate job performance. The use of ergonomic or adaptive equipment, therapeutic breaks, and interventional modalities at work may be necessary to maintain employment.

- g. Vocational Assistance:** Formal vocational rehabilitation is a generally accepted intervention and can assist disabled persons to return to viable employment. Identification of vocational goals will facilitate medical recovery and aid in the achievement of maximum medical improvement by (1) increasing motivation towards treatment and (2) alleviating the patient's emotional distress. Physically limited patients will benefit most if vocational assistance is provided during the interdisciplinary rehabilitation phase of treatment. To assess the patient's vocational capacity, a vocational assessment may utilize the information from occupational and physical therapy assessments. This vocational assessment may identify rehabilitation program goals and optimize both patient motivation and utilization of rehabilitation resources. This may be extremely helpful in decreasing the patient's fear regarding an inability to earn a living, which can add to his/her anxiety and depression.

**Recommendations to Employers and Employees of Small Businesses:** employees of small businesses who are diagnosed with chronic pain may not be able to perform any jobs for which openings exist. Temporary employees may fill those slots while the employee functionally improves. Some small businesses hire other workers, and if the injured employee returns to the job, the supervisor/owner may have an extra employee. Case managers may assist with resolution of these problems and with finding modified job tasks or jobs with reduced hours, etc., depending on company philosophy and employee needs.

**Recommendations to Employers and Employees of Mid-sized and Large Businesses:** Employers are encouraged by the Division to identify modified work within the company that may be available to injured workers with chronic pain who are returning to work with temporary or permanent restrictions. To assist with temporary or permanent placement of the injured worker, it is suggested that a program be implemented that allows the case manager to access descriptions of all jobs within the organization.

## **12. SLEEP DISTURBANCES**

Sleep disturbances are a common secondary symptom of cumulative trauma conditions. Although primary insomnia may accompany pain as an independent comorbid condition, it more commonly occurs secondary to the pain condition itself. Exacerbations of pain often are accompanied by exacerbations of insomnia; the reverse can also occur. Sleep laboratory studies have shown disturbances of sleep architecture in pain patients. Loss of deep slow-wave sleep and increase in light sleep occur and sleep efficiency, the proportion of time in bed spent asleep, is decreased. These changes are associated with patient reports of non-restorative sleep. Many affected patients develop behavioral habits that exacerbate and maintain sleep



disturbances. Excessive time in bed, irregular sleep routine, napping, low activity, and worrying in bed are all maladaptive responses that can arise in the absence of any psychopathology. Behavioral modifications are accepted interventions, easily implemented, and can include:

- a. Maintaining a regular sleep schedule, retiring and rising at approximately the same time on weekdays and weekends.
- b. Avoiding daytime napping.
- c. Avoiding caffeinated beverages after lunchtime.
- d. Making the bedroom quiet and comfortable, eliminating disruptive lights, sounds, television sets, and keeping a bedroom temperature of about 65 degrees Fahrenheit.
- e. Avoiding alcohol or nicotine within 2 hours of bedtime.
- f. Avoiding large meals within 2 hours of bedtime.
- g. Exercising vigorously during the day, but not within 2 hours of bedtime, since this may raise core temperature and activate the nervous system.
- h. Associating the bed with sleep and sexual activity only, using other parts of the home for television, reading, and talking on the telephone.
- i. Leaving the bedroom when unable to sleep for more than 20 minutes, returning to the bedroom when ready to sleep again.

These modifications should be undertaken before sleeping medication is prescribed for long-term use.

### **13. THERAPY–ACTIVE**

The following active therapies are widely used and accepted methods of care for a variety of work-related injuries. They are based on the philosophy that therapeutic exercise and/or activity are beneficial for restoring flexibility, strength, endurance, function, range of motion, and alleviating discomfort. Active therapy requires an internal effort by the individual to complete a specific exercise or task, and thus assists in developing skills promoting independence and self-care after discharge. This form of therapy requires supervision from a therapist or medical provider such as verbal, visual, and/or tactile instructions. At times a provider may help stabilize the patient or guide the movement pattern, but the energy required to complete the task is predominantly executed by the patient.

Patients should be instructed to continue active therapies at home as an extension of the treatment process in order to maintain improvement levels. Follow-up visits to reinforce and monitor progress and proper technique are recommended. Home exercise can include exercise with or without mechanical assistance or resistance and functional activities with assistive devices. Frequency times and duration of treatment apply only to diagnoses not previously covered in Sections F and G.

On occasion, specific diagnoses and post-surgical conditions may warrant durations of treatment beyond those listed as "maximum." Factors such as exacerbation of symptoms, re-injury, interrupted continuity of care, need for post-operative therapy, and co-morbidities may also extend durations of care. Specific goals with objectively measured functional improvement during treatment must be cited to justify extended durations of care. If no functional gain is observed after the number of treatments under "time to produce effect" has been completed, then the treatment should be discontinued and alternative treatment interventions, further diagnostic studies, or further consultations should be pursued.

- a. **Activities of Daily Living (ADLs)**: are well-established interventions which involve instruction, active-assisted training, and/or adaptation of activities or equipment to improve a person's capacity in normal daily activities such as self-care, work re-integration training, homemaking, and driving.
- ❖ Time to Produce Effect: 4 to 5 treatments.
  - ❖ Frequency: 3 to 5 times per week.
  - ❖ Optimum Duration: 4 to 6 weeks.
  - ❖ Maximum Duration: 6 weeks.
- b. **Functional Activities**: are generally well-accepted interventions which involve the use of therapeutic activity to enhance mobility, body mechanics, employability, coordination, and sensory motor integration.
- ❖ Time to Produce Effect: 4 to 5 treatments.
  - ❖ Frequency: 3 to 5 times per week.
  - ❖ Optimum Duration: 4 to 6 weeks.
  - ❖ Maximum Duration: 6 weeks.

c. **Nerve Gliding**: exercises are generally accepted. These exercises consist of a series of flexion and extension movements of the hand, wrist, elbow, shoulder, and neck, producing tension and longitudinal movement along the length of the median and other nerves of the upper extremity. These exercises are based on the principle that the tissues of the peripheral nervous system are designed for movement. The second principle is that tension and glide (excursion) of nerves may have an effect on neurophysiology through alterations in vascular and axoplasmic flow. Biomechanical principles have been more thoroughly studied than clinical outcomes. There is some evidence that a trial of conservative treatment for cubital tunnel syndrome, with emphasis on education, is as effective as a treatment program involving nocturnal bracing and a program involving gliding exercises. This education covers nerve anatomy, causes of symptoms, and appropriate elbow movements ([Svernlov et al., 2009](#)). Due to lack of quality evidence, use of mobilization and exercise should be based on patient preference and provider expertise ([Cochrane] ([Page et al., 2012](#))).

- ❖ Time to Produce Effect: 2 to 4 weeks.
- ❖ Frequency: Up to 5 times per day by patient (patient-initiated).
- ❖ Optimum Duration: 2 provider-directed sessions.
- ❖ Maximum Duration: 3 provider-directed sessions.

d. **Neuromuscular Re-education**: is an accepted treatment that involves the skilled application of exercise with manual, mechanical, or electrical facilitation. The goal is to enhance strength, movement patterns, neuromuscular response, proprioception, kinesthetic sense, coordination education of movement, balance, and posture. Indications include the need to promote neuromuscular responses through carefully timed proprioceptive stimuli, to elicit and improve motor activity in patterns similar to normal neurologically developed sequences, and improve neuromotor response with independent control.

- ❖ Time to Produce Effect: 2 to 6 treatments.
- ❖ Frequency: 3 times per week.
- ❖ Optimum Duration: 4 to 8 weeks.
- ❖ Maximum Duration: 8 weeks.

- e. **Proper Work Techniques**: Please refer to Section E.6.c Job Site Evaluations and Alterations and Section H.6 Job Site Alterations.
  
- f. **Therapeutic Exercise**: is generally well-accepted and widely used. It is done with or without mechanical assistance or resistance may include isoinertial, isotonic, isometric and isokinetic types of exercises. Indications include the need for cardiovascular fitness, reduced edema, improved muscle strength, improved connective tissue strength and integrity, increased bone density, promotion of circulation to enhance soft tissue healing, improvement of muscle recruitment, increased range of motion, and more normal movement patterns. The treatment can also include complementary/alternative exercise such as movement therapy (with oversight of a physician or other appropriate healthcare professional).
  - ❖ Time to Produce Effect: 2 to 6 treatments.
  - ❖ Frequency: 3 to 5 times per week.
  - ❖ Optimum Duration: 4 to 8 weeks.
  - ❖ Maximum Duration: 8 weeks.

#### 14. **THERAPY-PASSIVE**

Most of the following passive therapies and modalities are generally well-accepted methods of care for a variety of work-related injuries. This includes those treatment modalities that do not require energy expenditure on the part of the patient. They are principally effective during the early phases of treatment and are directed at controlling symptoms such as pain, inflammation, swelling, and at improving the rate of healing soft tissue injuries. They should be used in adjunct with active therapies to help control swelling, pain and inflammation during the rehabilitation process. They may be used intermittently as a therapist deems appropriate or regularly if there are specific goals with objectively measured functional improvements during treatment.

On occasion, specific diagnoses and post-surgical conditions may warrant durations of treatment beyond those listed as "maximum." Factors such as exacerbation of symptoms, re-injury, interrupted continuity of care, need for post-operative therapy, and co-morbidities may also extend durations of care. Specific goals with objectively measured functional improvement during treatment must be cited to justify extended durations of care. If no functional gain is observed after the number of treatments under "time to produce effect" has been completed, then the treatment should be discontinued and alternative treatment interventions, further diagnostic studies, or further consultations should be pursued.

The following passive therapies and modalities are listed in alphabetical order.

- a. **Electrical Stimulation (Unattended):** is an accepted treatment. Once applied, it requires minimal on-site supervision by the physician or non-physician provider. Indications include pain, inflammation, muscle spasm, atrophy, and decreased circulation.

Electrical stimulation is rarely used in cumulative trauma conditions. However, high voltage, galvanic, and/or interferential stimulators may assist in edema control to decrease pain and improve therapy compliance. It may be appropriate in rare situations when nerve damage or other work related issues have resulted in muscle atrophy and the patient is unable to engage in sufficient active therapy to increase muscle mass. TENS therapy or PENS are not indicated for diagnoses in these Guidelines. Refer to Exhibit 9 Chronic Pain Medical Treatment Guidelines for usage.

- ❖ Time to Produce Effect: 2 to 4 treatments.
- ❖ Frequency: Varies, depending upon indication, between 2 to 3 times/day to 1 time/week. Provide home unit if frequent use.
- ❖ Optimum Duration: 2 to 4 weeks.
- ❖ Maximum Duration: Home unit as needed.

- b. **Extracorporeal Shock Wave Therapy (ESWT):** The natural history of epicondylitis supports an expectation of improvement within 3 months using patient education and modified activities ([L. Bisset et al., 2006](#)).

There is some evidence that highly motivated tennis players may show up to a 35% additional improvement over no other treatment when administered low energy shock wave treatment without local anesthesia ([Rompe, 2004](#)). Two other studies are not of sufficient quality to qualify for evidence ([Ozturan et al., 2010](#); [Spacca et al., 2005](#)). There is some evidence that three weekly sessions of radial ESWT and sham ESWT lead to statistically similar symptomatic and functional outcomes at three months, but a benefit of radial ESWT cannot be ruled out due to uncertainties in the data.

The preponderance of evidence does not support the efficacy of ESWT in the working population; therefore, it is **not recommended**.

c. **Iontophoresis**: is an accepted treatment. It is the transfer of medication, including, but not limited to, steroidal anti-inflammatories and anesthetics, through the use of electrical stimulation. Indications include pain (lidocaine), inflammation (hydrocortisone, salicylate), edema (mecholyll, hyaluronidase, and salicylate), ischemia (magnesium, mecholyll, and iodine), muscle spasm (magnesium, calcium), calcific deposits (acetate), and scars and keloids (chlorine, iodine, acetate). Refer to the specific diagnosis for use with cumulative trauma. Under current FDA regulations, the physician issues a prescription to the patient for the dexamethasone for this treatment and the patient transports the medication to the treatment location.

- ❖ Time to Produce Effect: 1 to 4 treatments.
- ❖ Frequency: 2 to 3 times per week with at least 48 hours between treatments.
- ❖ Optimum Duration: 6 to 9 treatments.
- ❖ Maximum Duration: 9 treatments.

REFERENCED VERSION

- d. **Low Level Laser Therapy (LLLT):** There is some evidence that low-level laser therapy adds no short term benefit for reducing symptoms and improving function compared to full-time splinting for 3 months ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is good evidence that laser therapy is ineffective regarding pain and function compared with placebo as an intervention to treat carpal tunnel syndrome in the short term ([B. M. Huisstede, Hoogvliet, et al., 2010](#)). There is some evidence that LLLT is no more effective than placebo LLLT in reducing pain and symptoms and improving functionality in the conservative treatment of patients affected by carpal tunnel syndrome ([Tascioglu et al., 2012](#)). There is some evidence that LLLT plus splinting is no more effective than splinting alone in reducing carpal tunnel symptoms and improving functionality in the conservative treatment of patients affected by carpal tunnel syndrome ([Yagci et al., 2009](#)). There is good evidence that LLLT is not more effective than placebo for lateral epicondylitis ([L. Bisset et al., 2005](#)). *There is good evidence from a number of adequate studies comparing low level laser to sham therapy and splinting that low level laser does not add benefit, and it is **not recommended*** ([B. M. Huisstede, Hoogvliet, et al., 2010](#); [Tascioglu et al., 2012](#); [Yagci et al., 2009](#)).
- e. **Manipulation:** Is a generally accepted, well-established and widely used therapeutic intervention for upper extremity injuries. Manipulative treatment (not therapy) is defined as the therapeutic application of manually guided forces by an operator to improve physiologic function and/or support homeostasis that has been altered by the injury or occupational disease, and has associated clinical significance.

High velocity, low amplitude (HVLA) technique, chiropractic manipulation, osteopathic manipulation, muscle energy techniques, counter strain, and non-force techniques are all types of manipulative treatment. This may be applied by osteopathic physicians (D.O.), chiropractors (D.C.), properly trained physical therapists (P.T.), properly trained occupational therapists (O.T.), or properly trained physicians. Under these different types of manipulation exist many subsets of different techniques that can be described as a) "direct," or a forceful engagement of a restrictive/pathologic barrier; b) "indirect," or a gentle/non-forceful disengagement of a restrictive/pathologic barrier; c) the patient actively assisting in the treatment; and d) the patient relaxing, allowing the practitioner to move the body tissues. When the proper diagnosis is made and coupled with the appropriate technique, manipulation has no contraindications and can be applied to all tissues of the body. Pre-treatment assessment should be performed as part of each manipulative treatment visit to ensure that the correct diagnosis and correct treatment is employed. Refer to the specific diagnosis for use with cumulative trauma conditions.

There is good evidence that manual and manipulative therapy combined with exercise and/or multimodal therapy shows small, clinically important

reductions in pain and improved physical function in the short-term care ( $\leq 3$ -6 months) of patients with lateral epicondylitis and carpal tunnel syndrome ([Brantingham et al., 2013](#)).

There is some evidence that both Cyriax physiotherapy (deep transverse friction massage combined with mills manipulation) and phonophoresis with supervised exercise and static stretching are effective over 4 weeks. Both treatments decrease pain, increase pain-free grip strength, and improve functional status in people with lateral epicondylalgia. However, Cyriax physiotherapy provides a superior benefit compared to phonophoresis with supervised exercise and static stretching ([Nagrale et al., 2009](#)).

- ❖ Time to Produce Effect (for all types of manipulative treatment): 1 to 6 treatments.
- ❖ Frequency: Up to 3 times per week for the first 3 weeks as indicated by the severity of involvement and the desired effect.
- ❖ Optimum Duration: 10 treatments.
- ❖ Maximum Duration: 12 treatments. Additional visits may be necessary in cases of re-injury, interrupted continuity of care, exacerbation of symptoms, and in those patients with co-morbidities. Functional gains including increased ROM must be demonstrated to justify continuing treatment.

- f. **Manual Therapy Techniques:** are passive interventions in which the provider uses his/her hands to administer skilled movements. The movements are designed to modulate pain; increase joint range of motion; reduce/eliminate soft tissue swelling, inflammation or restriction; induce relaxation; and improve contractile and non-contractile tissue extensibility. These generally accepted techniques are applied only after a thorough examination is performed to identify those for whom manual therapy would be contraindicated or for whom manual therapy must be applied with caution.

There is some evidence that the muscle energy technique is superior to corticosteroid injection in improving grip strength in lateral epicondylitis ([Kucuksen et al., 2013](#)). The muscle energy technique is a manual therapy technique in which the patient performs voluntary contraction against a counter force from the provider to stretch muscles and improve range of motion. However, it is not clear that the technique is better than no treatment.

There is good evidence that manual and manipulative therapy combined with exercise and/or multimodal therapy shows small, clinically important



reductions in pain and improved physical function in the short-term care ( $\leq 3$ -6 months) of patients with lateral epicondylitis and carpal tunnel syndrome ([Brantingham et al., 2013](#)).

There is some evidence that both Cyriax physiotherapy (deep transverse friction massage combined with mills manipulation) and phonophoresis with supervised exercise and static stretching are effective over 4 weeks. Both treatments decrease pain, increase pain-free grip strength, and improve functional status in people with lateral epicondylalgia. However, Cyriax physiotherapy provides a superior benefit compared to phonophoresis with supervised exercise and static stretching ([Nagrale et al., 2009](#)).

i. Mobilization (Joint)/Manipulation: Mobilization is passive movement involving oscillatory motions to the involved joints. The passive mobility is performed in a graded manner (I, II, III, IV, or V), which depicts the speed of the maneuver. It may include skilled manual joint tissue stretching. Indications include the need to improve joint play, improve intracapsular arthrokinematics, or reduce pain associated with tissue impingement. Contraindications include joint instability, fractures, severe osteoporosis, infection, metastatic cancer, active inflammatory arthritides, and signs of progressive neurologic deficits.

- ❖ Time to Produce Effect: 4 to 6 treatments.
- ❖ Frequency: 2 to 3 times per week.
- ❖ Optimum Duration: 4 to 6 weeks.
- ❖ Maximum Duration: 6 weeks.

ii. Mobilization (Soft Tissue): Mobilization of soft tissue is the skilled application of manual techniques designed to normalize movement patterns through the reduction of soft tissue pain and restrictions. Indications include muscle spasm around a joint, trigger points, adhesions, and neural compression.

- ❖ Time to Produce Effect: 4 to 6 treatments.
- ❖ Frequency: 2 to 3 times per week.
- ❖ Optimum Duration: 4 to 6 weeks.
- ❖ Maximum Duration: 6 weeks.

**g. Massage, Manual or Mechanical:** Massage is manipulation of soft tissue with broad ranging relaxation and circulatory benefits. It is an accepted treatment. This may include stimulation of acupuncture points and acupuncture channels (acupressure), application of suction cups, and techniques that include pressing, lifting, rubbing, pinching of soft tissues by or with the practitioners' hands. Indications include edema, muscle spasm, adhesions, the need to improve peripheral circulation and range of motion, or to increase muscle relaxation and flexibility prior to exercise.

- ❖ Time to Produce Effect: Immediate.
- ❖ Frequency: 1 to 2 times per week.
- ❖ Optimum Duration: 6 weeks.
- ❖ Maximum Duration: 2 months.

**h. Orthotics/Immobilization with Splinting and Bracing:** is a generally accepted, well-established and widely used therapeutic procedure. Depending on the specifics of the condition, the treatment plan, and the daily activities, splints may be effective when worn at night or during portions of the day. Splints should be loose and soft enough to maintain comfort while supporting the involved joint in a relatively neutral position.

Splint comfort is critical and may affect compliance. Although off-the-shelf splints are usually sufficient, custom thermoplastic splints may provide better fit for certain patients. Splint use is rarely mandatory. Providers should be aware that over usage is counterproductive, and counsel patients to minimize daytime splint use in order avoid detrimental effects, such as, stiffness and dependency over time.

- ❖ Time to Produce Effect: 1 to 4 weeks.
- ❖ Frequency: Daytime intermittent or night use, depending on symptoms and activities.
- ❖ Optimum Duration: 4 to 8 weeks.
- ❖ Maximum Duration: 2 to 4 months. If symptoms persist, consideration should be given to further diagnostic studies or to other treatment options.

i. **Paraffin Bath:** is a superficial heating modality that uses melted paraffin (candle wax and mineral oil) to treat irregular surfaces such as the hand. Accepted indications include the need to enhance collagen extensibility before stretching, reduce muscle guarding, or reduce inflammatory response.

- ❖ Time to Produce Effect: 1 to 4 treatments.
- ❖ Frequency: 1 to 3 times per week.
- ❖ Optimum Duration: 4 weeks.
- ❖ Maximum Duration: 1 month. If beneficial, provide with home unit or purchase if effective.

j. **Superficial Heat and Cold Therapy:** is an accepted intervention. Thermal agents are applied in various manners that lower or raise the body tissue temperature for the reduction of pain, inflammation, and/or effusion resulting from injury or induced by exercise. It includes application of heat just above the surface of the skin at acupuncture points. Indications include acute pain, edema, and hemorrhage and the need to increase pain threshold, reduce muscle spasm, and promote stretching/flexibility. Cold and heat packs can be used at home as an extension of therapy in the clinic setting.

- ❖ Time to Produce Effect: Immediate.
- ❖ Frequency: 2 to 5 times per week (clinic). Home treatment as needed.
- ❖ Optimum Duration: 3 weeks as primary or intermittently as an adjunct to other therapeutic procedures up to 2 months.
- ❖ Maximum Duration: 2 months. If symptoms persist, provider should consider further diagnostic studies or other treatment options.

k. **Ultrasound (Including Phonophoresis):** is an accepted treatment. It uses sonic generators to deliver acoustic energy for therapeutic thermal and/or non-thermal soft tissue effects. Refer to Sections F and G on specific diagnoses for use. Indications include scar tissue, adhesions, collagen fiber, muscle spasm, and to improve muscle tissue extensibility and soft tissue healing. Ultrasound with electrical stimulation is concurrent delivery of electrical energy that involves dispersive electrode placement. Indications include: muscle spasm, scar tissue, pain modulation, and muscle facilitation. Phonophoresis is the transfer of medication to the target tissue to control inflammation and pain through the use of sonic generators. These topical medications include, but are not limited to, steroidal anti-inflammatory and anesthetics. Under current FDA regulations, the physician issues a prescription to the patient for the dexamethasone for this treatment and the patient usually transports the medication to the treatment location.

- ❖ Time to Produce Effect: 4 to 8 treatments.
- ❖ Frequency: 2 to 3 times per week.
- ❖ Optimum Duration: 4 to 6 weeks.
- ❖ Maximum Duration: 2 months.

15. **VOCATIONAL REHABILITATION**

**VOCATIONAL REHABILITATION:** is a generally accepted intervention. However, Senate Bill 87-79 limits the use of vocational rehabilitation in Colorado. This treatment requires adequate evaluation of patients for quantification of highest functional level, motivation, and achievement of maximum medical improvement (MMI). Vocational rehabilitation may be as simple as returning to the original job or as complicated as being retrained for a new occupation. The effectiveness of vocational rehabilitation may be enhanced when performed in combination with work hardening and work conditioning.

It may also be beneficial for full vocational rehabilitation to be started before MMI if it is evident that the injured worker will be unable to return to his/her previous occupation. A positive goal and direction may aid the patient in decreasing stress and depression, and promote optimum rehabilitation.

## In-Text References

- Abrams, R. (2009). Endoscopic versus open carpal tunnel release. *J Hand Surg Am*, 34(3), 535-539. doi:10.1016/j.jhsa.2009.01.013
- Adams, B. D., Pomerance, J., Nguyen, A., & Kuhl, T. L. (2009). Early outcome of spherical ceramic trapezial-metacarpal arthroplasty. *J Hand Surg Am*, 34(2), 213-218. doi:10.1016/j.jhsa.2008.10.017
- Adams, J. E. (2014). Does arthroscopic debridement with or without interposition material address carpometacarpal arthritis? *Clin Orthop Relat Res*, 472(4), 1166-1172. doi:10.1007/s11999-013-2905-y
- Adams, J. E., & Habbu, R. (2015). Tendinopathies of the Hand and Wrist. *J Am Acad Orthop Surg*, 23(12), 741-750. doi:10.5435/JAAOS-D-14-00216
- Ahsan, Z. S., & Yao, J. (2012). Complications of wrist arthroscopy. *Arthroscopy*, 28(6), 855-859. doi:10.1016/j.arthro.2012.01.008
- Ali, K. M., & Sathiyasekaran, B. W. (2006). Computer professionals and Carpal Tunnel Syndrome (CTS). *Int J Occup Saf Ergon*, 12(3), 319-325. doi:10.1080/10803548.2006.11076691
- Altman, R. D., Dreiser, R. L., Fisher, C. L., Chase, W. F., Dreher, D. S., & Zacher, J. (2009). Diclofenac sodium gel in patients with primary hand osteoarthritis: a randomized, double-blind, placebo-controlled trial. *J Rheumatol*, 36(9), 1991-1999. doi:10.3899/jrheum.081316
- Amadio, P. C. (2009). Interventions for recurrent/persistent carpal tunnel syndrome after carpal tunnel release. *J Hand Surg Am*, 34(7), 1320-1322. doi:10.1016/j.jhsa.2009.04.031
- American Association of Neuromuscular & Electrodiagnostic Medicine. (2002). Practice parameter for electrodiagnostic studies in carpal tunnel syndrome: Summary statement. *Muscle Nerve*, 25, 918-923.
- Andersen, J. H., Thomsen, J. F., Overgaard, E., Lassen, C. F., Brandt, L. P., Vilstrup, I., . . . Mikkelsen, S. (2003). Computer use and carpal tunnel syndrome: a 1-year follow-up study. *JAMA*, 289(22), 2963-2969. doi:10.1001/jama.289.22.2963

- Arik, H. O., Kose, O., Guler, F., Deniz, G., Egerci, O. F., & Ucar, M. (2014). Injection of autologous blood versus corticosteroid for lateral epicondylitis: a randomised controlled study. *J Orthop Surg (Hong Kong)*, 22(3), 333-337.
- Armagan, O., Bakilan, F., Ozgen, M., Mehmetoglu, O., & Oner, S. (2014). Effects of placebo-controlled continuous and pulsed ultrasound treatments on carpal tunnel syndrome: a randomized trial. *Clinics (Sao Paulo)*, 69(8), 524-528.
- Ashraf, M. O., & Devadoss, V. G. (2014). Systematic review and meta-analysis on steroid injection therapy for de Quervain's tenosynovitis in adults. *Eur J Orthop Surg Traumatol*, 24(2), 149-157. doi:10.1007/s00590-012-1164-z
- Ashworth, N. L. (2010). Carpal tunnel syndrome. *BMJ Clin Evid*, 2010.
- Ashworth, N. L. (2015). Carpal tunnel syndrome. *BMJ Clin Evid*, 2015.
- Assmus, H., Antoniadis, G., & Bischoff, C. (2015). Carpal and cubital tunnel and other, rarer nerve compression syndromes. *Dtsch Arztebl Int*, 112(1-2), 14-25; quiz 26. doi:10.3238/arztebl.2015.0014
- Assmus, H., Antoniadis, G., Bischoff, C., Hoffmann, R., Martini, A. K., Preissler, P., . . . Wustner-Hofmann, M. (2011). Cubital tunnel syndrome - a review and management guidelines. *Cent Eur Neurosurg*, 72(2), 90-98. doi:10.1055/s-0031-1271800
- Atcheson, S. G., Ward, J. R., & Lowe, W. (1998). Concurrent medical disease in work-related carpal tunnel syndrome. *Arch Intern Med*, 158(14), 1506-1512.
- Atroshi, I., Flondell, M., Hofer, M., & Ranstam, J. (2013). Methylprednisolone injections for the carpal tunnel syndrome: a randomized, placebo-controlled trial. *Ann Intern Med*, 159(5), 309-317. doi:10.7326/0003-4819-159-5-201309030-00004
- Atroshi, I., Gummesson, C., Ornstein, E., Johnsson, R., & Ranstam, J. (2007). Carpal tunnel syndrome and keyboard use at work: a population-based study. *Arthritis Rheum*, 56(11), 3620-3625. doi:10.1002/art.22956
- Atroshi, I., Hofer, M., Larsson, G. U., Ornstein, E., Johnsson, R., & Ranstam, J. (2009). Open compared with 2-portal endoscopic carpal tunnel release: a 5-year follow-up of a randomized controlled trial. *J Hand Surg Am*, 34(2), 266-272. doi:10.1016/j.jhsa.2008.10.026

- Atroshi, I., Hofer, M., Larsson, G. U., & Ranstam, J. (2015). Extended Follow-up of a Randomized Clinical Trial of Open vs Endoscopic Release Surgery for Carpal Tunnel Syndrome. *JAMA*, 314(13), 1399-1401. doi:10.1001/jama.2015.12208
- Baker, N. A., & Livengood, H. M. (2014). Symptom severity and conservative treatment for carpal tunnel syndrome in association with eventual carpal tunnel release. *J Hand Surg Am*, 39(9), 1792-1798. doi:10.1016/j.jhsa.2014.04.034
- Baker, T. B., Piper, M. E., Stein, J. H., Smith, S. S., Bolt, D. M., Fraser, D. L., & Fiore, M. C. (2016). Effects of Nicotine Patch vs Varenicline vs Combination Nicotine Replacement Therapy on Smoking Cessation at 26 Weeks: A Randomized Clinical Trial. *JAMA*, 315(4), 371-379. doi:10.1001/jama.2015.19284
- Bannuru, R. R., Schmid, C. H., Kent, D. M., Vaysbrot, E. E., Wong, J. B., & McAlindon, T. E. (2015). Comparative effectiveness of pharmacologic interventions for knee osteoarthritis: a systematic review and network meta-analysis. *Ann Intern Med*, 162(1), 46-54. doi:10.7326/M14-1231
- Batteson, R., Hammond, A., Burke, F., & Sinha, S. (2008). The de Quervain's screening tool: validity and reliability of a measure to support clinical diagnosis and management. *Musculoskeletal Care*, 6(3), 168-180. doi:10.1002/msc.129
- Beck, J. D., Brothers, J. G., Maloney, P. J., Deegan, J. H., Tang, X., & Klena, J. C. (2012). Predicting the outcome of revision carpal tunnel release. *J Hand Surg Am*, 37(2), 282-287. doi:10.1016/j.jhsa.2011.10.040
- Becker, S. J., Makanji, H. S., & Ring, D. (2014). Changes in treatment plan for carpal tunnel syndrome based on electrodiagnostic test results. *J Hand Surg Eur Vol*, 39(2), 187-193. doi:10.1177/1753193413497903
- Belcher, H. J., & Nicholl, J. E. (2000). A comparison of trapeziectomy with and without ligament reconstruction and tendon interposition. *J Hand Surg Br*, 25(4), 350-356. doi:10.1054/jhsb.2000.0431
- Berggren, M., Joost-Davidsson, A., Lindstrand, J., Nylander, G., & Povlsen, B. (2001). Reduction in the need for operation after conservative treatment of osteoarthritis of the first carpometacarpal joint: a seven year prospective study. *Scand J Plast Reconstr Surg Hand Surg*, 35(4), 415-417.
- Bernstein, M. A., Nagle, D. J., Martinez, A., Stogin, J. M., Jr., & Wiedrich, T. A. (2004). A comparison of combined arthroscopic triangular fibrocartilage complex debridement and arthroscopic wafer

- distal ulna resection versus arthroscopic triangular fibrocartilage complex debridement and ulnar shortening osteotomy for ulnocarpal abutment syndrome. *Arthroscopy*, 20(4), 392-401. doi:10.1016/j.arthro.2004.01.013
- Biggs, M., & Curtis, J. A. (2006). Randomized, prospective study comparing ulnar neurolysis in situ with submuscular transposition. *Neurosurgery*, 58(2), 296-304; discussion 296-304. doi:10.1227/01.NEU.0000194847.04143.A1
- Bilkis, S., Loveman, D. M., Eldridge, J. A., Ali, S. A., Kadir, A., & McConathy, W. (2012). Modified Phalen's test as an aid in diagnosing carpal tunnel syndrome. *Arthritis Care Res (Hoboken)*, 64(2), 287-289. doi:10.1002/acr.20664
- Bisset, L., Beller, E., Jull, G., Brooks, P., Darnell, R., & Vicenzino, B. (2006). Mobilisation with movement and exercise, corticosteroid injection, or wait and see for tennis elbow: randomised trial. *BMJ*, 333(7575), 939. doi:10.1136/bmj.38961.584653.AE
- Bisset, L., Paungmali, A., Vicenzino, B., & Beller, E. (2005). A systematic review and meta-analysis of clinical trials on physical interventions for lateral epicondylalgia. *Br J Sports Med*, 39(7), 411-422; discussion 411-422. doi:10.1136/bjism.2004.016170
- Bisset, L. M., Collins, N. J., & Offord, S. S. (2014). Immediate effects of 2 types of braces on pain and grip strength in people with lateral epicondylalgia: a randomized controlled trial. *J Orthop Sports Phys Ther*, 44(2), 120-128. doi:10.2519/jospt.2014.4744
- Boocock, M. G., Collier, J. M., McNair, P. J., Simmonds, M., Larmer, P. J., & Armstrong, B. (2009). A framework for the classification and diagnosis of work-related upper extremity conditions: systematic review. *Semin Arthritis Rheum*, 38(4), 296-311. doi:10.1016/j.semarthrit.2007.10.006
- Boya, H., Ozcan, O., & Oztekin, H. H. (2008). Long-term complications of open carpal tunnel release. *Muscle Nerve*, 38(5), 1443-1446. doi:10.1002/mus.21068
- Brantingham, J. W., Cassa, T. K., Bonnefin, D., Pribicevic, M., Robb, A., Pollard, H., . . . Korporaal, C. (2013). Manipulative and multimodal therapy for upper extremity and temporomandibular disorders: a systematic review. *J Manipulative Physiol Ther*, 36(3), 143-201. doi:10.1016/j.jmpt.2013.04.001
- Bridgeman, C., Naidu, S., & Kothari, M. J. (2007). Clinical and electrophysiological presentation of pronator syndrome. *Electromyogr Clin Neurophysiol*, 47(2), 89-92.



- Brouwer, S., Dijkstra, P. U., Stewart, R. E., Goeken, L. N., Groothoff, J. W., & Geertzen, J. H. (2005). Comparing self-report, clinical examination and functional testing in the assessment of work-related limitations in patients with chronic low back pain. *Disabil Rehabil*, 27(17), 999-1005. doi:10.1080/09638280500052823
- Buchbinder, R., Johnston, R. V., Barnsley, L., Assendelft, W. J., Bell, S. N., & Smidt, N. (2011). Surgery for lateral elbow pain. *Cochrane Database Syst Rev*(3), CD003525. doi:10.1002/14651858.CD003525.pub2
- Burke, F. D., Bradley, M. J., Sinha, S., Wilgis, E. F., & Dubin, N. H. (2007). Primary care management of patients with carpal tunnel syndrome referred to surgeons: are non-operative interventions effectively utilised? *Postgrad Med J*, 83(981), 498-501. doi:10.1136/pgmj.2007.058206
- Burke, F. D., Wilgis, E. F., Dubin, N. H., Bradley, M. J., & Sinha, S. (2006). Relationship between the duration and severity of symptoms and the outcome of carpal tunnel surgery. *J Hand Surg Am*, 31(9), 1478-1482. doi:10.1016/j.jhsa.2006.08.017
- Caldwell, J. R. (1996). Intra-articular corticosteroids. Guide to selection and indications for use. *Drugs*, 52(4), 507-514.
- Calfee, R., Chu, J., Sorensen, A., Martens, E., & Elfar, J. (2015). What Is the Impact of Comorbidities on Self-rated Hand Function in Patients With Symptomatic Trapeziometacarpal Arthritis? *Clin Orthop Relat Res*, 473(11), 3477-3483. doi:10.1007/s11999-015-4507-3
- Caliandro, P., La Torre, G., Padua, R., Giannini, F., & Padua, L. (2012). Treatment for ulnar neuropathy at the elbow. *Cochrane Database Syst Rev*(7), Cd006839. doi:10.1002/14651858.CD006839.pub3
- California / Occupational Safety & Health Administration Cal/OSHA. (1999). Easy ergonomics. Retrieved from [http://www.dir.ca.gov/dosh/dosh\\_publications/ComputerErgo.pdf](http://www.dir.ca.gov/dosh/dosh_publications/ComputerErgo.pdf)
- Campbell, W. W., & Landau, M. E. (2008). Controversial entrapment neuropathies. *Neurosurg Clin N Am*, 19(4), 597-608, vi-vii. doi:10.1016/j.nec.2008.07.001
- Cantor, R. M., Stern, P. J., Wyrick, J. D., & Michaels, S. E. (1994). The relevance of ligament tears or perforations in the diagnosis of wrist pain: an arthrographic study. *J Hand Surg Am*, 19(6), 945-953. doi:10.1016/0363-5023(94)90094-9
- Capan, N., Esmailzadeh, S., Oral, A., Basoglu, C., Karan, A., & Sindel, D. (2016). Radial Extracorporeal Shock Wave Therapy Is Not More Effective Than Placebo in the Management

of Lateral Epicondylitis: A Double-Blind, Randomized, Placebo-Controlled Trial. *Am J Phys Med Rehabil*, 95(7), 495-506. doi:10.1097/PHM.0000000000000407

Capasso, M., Manzoli, C., & Uncini, A. (2009). Management of extreme carpal tunnel syndrome: evidence from a long-term follow-up study. *Muscle Nerve*, 40(1), 86-93. doi:10.1002/mus.21265

CARF. (2010-2011). *Medical Rehabilitation Standards Manual*. United States of America: Commission on Accreditation of Rehabilitation Facilities.

Carter, G. T., Weiss, M. D., Friedman, A. S., Allan, C. H., & Robinson, L. (2015). Diagnosis and Treatment of Work-Related Ulnar Neuropathy at the Elbow. *Phys Med Rehabil Clin N Am*, 26(3), 513-522. doi:10.1016/j.pmr.2015.04.002

Chammas, M. (2014). Carpal tunnel syndrome. *Chir Main*, 33(2), 75-94. doi:10.1016/j.main.2013.11.010

Cherniack, M., Brammer, A. J., Lundstrom, R., Morse, T. F., Neely, G., Nilsson, T., . . . Dussetschleger, J. (2008). Syndromes from segmental vibration and nerve entrapment: observations on case definitions for carpal tunnel syndrome. *Int Arch Occup Environ Health*, 81(5), 661-669. doi:10.1007/s00420-007-0268-y

Chiang, H. C., Chen, S. S., Yu, H. S., & Ko, Y. C. (1990). The occurrence of carpal tunnel syndrome in frozen food factory employees. *Gaoxiong Yi Xue Ke Xue Za Zhi*, 6(2), 73-80.

Cho, Y. J., Song, Y. K., Cha, Y. Y., Shin, B. C., Shin, I. H., Park, H. J., . . . Song, M. Y. (2013). Acupuncture for chronic low back pain: a multicenter, randomized, patient-assessor blind, sham-controlled clinical trial. *Spine (Phila Pa 1976)*, 38(7), 549-557. doi:10.1097/BRS.0b013e318275e601

Cook, A. C., Szabo, R. M., Birkholz, S. W., & King, E. F. (1995). Early mobilization following carpal tunnel release. A prospective randomized study. *J Hand Surg Br*, 20(2), 228-230.

Coombes, B. K., Bisset, L., Brooks, P., Khan, A., & Vicenzino, B. (2013). Effect of corticosteroid injection, physiotherapy, or both on clinical outcomes in patients with unilateral lateral epicondylalgia: a randomized controlled trial. *JAMA*, 309(5), 461-469. doi:10.1001/jama.2013.129

- Coombes, B. K., Bisset, L., & Vicenzino, B. (2010). Efficacy and safety of corticosteroid injections and other injections for management of tendinopathy: a systematic review of randomised controlled trials. *Lancet*, 376(9754), 1751-1767. doi:10.1016/s0140-6736(10)61160-9
- Cowan, J., Makanji, H., Mudgal, C., Jupiter, J., & Ring, D. (2012). Determinants of return to work after carpal tunnel release. *J Hand Surg Am*, 37(1), 18-27. doi:10.1016/j.jhsa.2011.10.033
- Currie, S. R., Wilson, K. G., Pontefract, A. J., & deLaplante, L. (2000). Cognitive-behavioral treatment of insomnia secondary to chronic pain. *J Consult Clin Psychol*, 68(3), 407-416.
- da Costa, V. V., de Oliveira, S. B., Fernandes Mdo, C., & Saraiva, R. A. (2011). Incidence of regional pain syndrome after carpal tunnel release. Is there a correlation with the anesthetic technique? *Rev Bras Anesthesiol*, 61(4), 425-433. doi:10.1016/s0034-7094(11)70050-2
- Darowish, M., Lawton, J. N., & Evans, P. J. (2009). Q:What is cell phone elbow, and what should we tell our patients? *Cleve Clin J Med*, 76(5), 306-308. doi:10.3949/ccjm.76a.08090
- Davis, T. R., Brady, O., & Dias, J. J. (2004). Excision of the trapezium for osteoarthritis of the trapeziometacarpal joint: a study of the benefit of ligament reconstruction or tendon interposition. *J Hand Surg Am*, 29(6), 1069-1077. doi:10.1016/j.jhsa.2004.06.017
- Day, C. S., & Ramirez, M. A. (2006). Thumb metacarpophalangeal arthritis: arthroplasty or fusion? *Hand Clin*, 22(2), 211-220. doi:10.1016/j.hcl.2006.02.010
- Derry, S., Moore, R. A., Gaskell, H., McIntyre, M., & Wiffen, P. J. (2015). Topical NSAIDs for acute musculoskeletal pain in adults. *Cochrane Database Syst Rev*(6), CD007402. doi:10.1002/14651858.CD007402.pub3
- Descatha, A., Dale, A. M., Jaegers, L., Herquelot, E., & Evanoff, B. (2013). Self-reported physical exposure association with medial and lateral epicondylitis incidence in a large longitudinal study. *Occup Environ Med*, 70(9), 670-673. doi:10.1136/oemed-2012-101341
- Descatha, A., Leclerc, A., Chastang, J. F., Roquelaure, Y., & Study Group on Repetitive, W. (2003). Medial epicondylitis in occupational settings: prevalence, incidence and associated risk factors. *J Occup Environ Med*, 45(9), 993-1001. doi:10.1097/01.jom.0000085888.37273.d9
- Descatha, A., Leclerc, A., Chastang, J. F., Roquelaure, Y., & Study Group on Repetitive, W. (2004). Incidence of ulnar nerve entrapment at the elbow in repetitive work. *Scand J Work Environ Health*, 30(3), 234-240.

- Dingemans, R., Randsdorp, M., Koes, B. W., & Huisstede, B. M. (2014). Evidence for the effectiveness of electrophysical modalities for treatment of medial and lateral epicondylitis: a systematic review. *Br J Sports Med*, 48(12), 957-965. doi:10.1136/bjsports-2012-091513
- Dobscha, S. K., Corson, K., Perrin, N. A., Hanson, G. C., Leibowitz, R. Q., Doak, M. N., . . . Gerrity, M. S. (2009). Collaborative care for chronic pain in primary care: a cluster randomized trial. *JAMA*, 301(12), 1242-1252. doi:10.1001/jama.2009.377
- Eccleston, C., Williams, A. C., & Morley, S. (2009). Psychological therapies for the management of chronic pain (excluding headache) in adults. *Cochrane Database Syst Rev*(2), CD007407. doi:10.1002/14651858.CD007407.pub2
- Edmonds, L. C., Vance, M. L., & Hughes, J. M. (1991). Morbidity from paraspinal depo corticosteroid injections for analgesia: Cushing's syndrome and adrenal suppression. *Anesth Analg*, 72(6), 820-822.
- Elfar, J. C., Yaseen, Z., Stern, P. J., & Kiefhaber, T. R. (2010). Individual finger sensibility in carpal tunnel syndrome. *J Hand Surg Am*, 35(11), 1807-1812. doi:10.1016/j.jhsa.2010.08.013
- Erkin, G., Uysal, H., Keles, I., Aybay, C., & Ozel, S. (2006). Acute ulnar neuropathy at the wrist: a case report and review of the literature. *Rheumatol Int*, 27(2), 191-196. doi:10.1007/s00296-006-0166-8
- Espandar, R., Heidari, P., Rasouli, M. R., Saadat, S., Farzan, M., Rostami, M., . . . Mortazavi, S. M. (2010). Use of anatomic measurement to guide injection of botulinum toxin for the management of chronic lateral epicondylitis: a randomized controlled trial. *CMAJ*, 182(8), 768-773. doi:10.1503/cmaj.090906
- Even, J. L., Crosby, C. G., Song, Y., McGirt, M. J., & Devin, C. J. (2012). Effects of epidural steroid injections on blood glucose levels in patients with diabetes mellitus. *Spine (Phila Pa 1976)*, 37(1), E46-50. doi:10.1097/BRS.0b013e31821fd21f
- Fan, Z. J., Silverstein, B. A., Bao, S., Bonauto, D. K., Howard, N. L., & Smith, C. K. (2014). The association between combination of hand force and forearm posture and incidence of lateral epicondylitis in a working population. *Hum Factors*, 56(1), 151-165.
- Fan, Z. J., Silverstein, B. A., Bao, S., Bonauto, D. K., Howard, N. L., Spielholz, P. O., . . . Viikari-Juntura, E. (2009). Quantitative exposure-response relations between physical workload and prevalence of lateral epicondylitis in a working population. *Am J Ind Med*, 52(6), 479-490. doi:10.1002/ajim.20700

- Farzad, M., Asgari, A., Dashab, F., Layeghi, F., Karimlou, M., Hosseini, S. A., & Rassafiani, M. (2015). Does Disability Correlate With Impairment After Hand Injury? *Clin Orthop Relat Res*, 473(11), 3470-3476. doi:10.1007/s11999-015-4228-7
- Fernandez-de-Las Penas, C., Ortega-Santiago, R., de la Llave-Rincon, A. I., Martinez-Perez, A., Fahandezh-Saddi Diaz, H., Martinez-Martin, J., . . . Cuadrado-Perez, M. L. (2015). Manual Physical Therapy Versus Surgery for Carpal Tunnel Syndrome: A Randomized Parallel-Group Trial. *J Pain*, 16(11), 1087-1094. doi:10.1016/j.jpain.2015.07.012
- Feveile, H., Jensen, C., & Burr, H. (2002). Risk factors for neck-shoulder and wrist-hand symptoms in a 5-year follow-up study of 3,990 employees in Denmark. *Int Arch Occup Environ Health*, 75(4), 243-251. doi:10.1007/s00420-001-0298-9
- Figen Ayhan, F., & Ustun, N. (2009). The evaluation of efficacy and tolerability of Hylan G-F 20 in bilateral thumb base osteoarthritis: 6 months follow-up. *Clin Rheumatol*, 28(5), 535-541. doi:10.1007/s10067-008-1080-0
- Fink, M., Wolkenstein, E., Luennemann, M., Gutenbrunner, C., Gehrke, A., & Karst, M. (2002). Chronic epicondylitis: effects of real and sham acupuncture treatment: a randomised controlled patient- and examiner-blinded long-term trial. *Forsch Komplementarmed Klass Naturheilkd*, 9(4), 210-215. doi:66030
- Fontana, L., Neel, S., Claise, J. M., Ughetto, S., & Catilina, P. (2007). Osteoarthritis of the thumb carpometacarpal joint in women and occupational risk factors: a case-control study. *J Hand Surg Am*, 32(4), 459-465. doi:10.1016/j.jhsa.2007.01.014
- Forogh, B., Khalighi, M., Javanshir, M. A., Ghoseiri, K., Kamali, M., & Raissi, G. (2012). The effects of a new designed forearm orthosis in treatment of lateral epicondylitis. *Disabil Rehabil Assist Technol*, 7(4), 336-339. doi:10.3109/17483107.2011.635330
- Forthman, C. L. (2009). Management of advanced trapeziometacarpal arthrosis. *J Hand Surg Am*, 34(2), 331-334. doi:10.1016/j.jhsa.2008.11.028
- Frost, P., Andersen, J. H., & Nielsen, V. K. (1998). Occurrence of carpal tunnel syndrome among slaughterhouse workers. *Scand J Work Environ Health*, 24(4), 285-292.
- Fuchs, S., Monikes, R., Wohlmeiner, A., & Heyse, T. (2006). Intra-articular hyaluronic acid compared with corticoid injections for the treatment of rhizarthrosis. *Osteoarthritis Cartilage*, 14(1), 82-88. doi:10.1016/j.joca.2005.07.016

- Gardner, B. T., Dale, A. M., VanDillen, L., Franzblau, A., & Evanoff, B. A. (2008). Predictors of upper extremity symptoms and functional impairment among workers employed for 6 months in a new job. *Am J Ind Med*, *51*(12), 932-940. doi:10.1002/ajim.20625
- Garfinkel, M. S., Singhal, A., Katz, W. A., Allan, D. A., Reshetar, R., & Schumacher, H. R., Jr. (1998). Yoga-based intervention for carpal tunnel syndrome: a randomized trial. *JAMA*, *280*(18), 1601-1603.
- Garg, R., Adamson, G. J., Dawson, P. A., Shankwiler, J. A., & Pink, M. M. (2010). A prospective randomized study comparing a forearm strap brace versus a wrist splint for the treatment of lateral epicondylitis. *J Shoulder Elbow Surg*, *19*(4), 508-512. doi:10.1016/j.jse.2009.12.015
- Gatchel, R. J., Polatin, P. B., Mayer, T. G., & Garcy, P. D. (1994). Psychopathology and the rehabilitation of patients with chronic low back pain disability. *Arch Phys Med Rehabil*, *75*(6), 666-670.
- Gell, N., Werner, R. A., Franzblau, A., Ulin, S. S., & Armstrong, T. J. (2005). A longitudinal study of industrial and clerical workers: incidence of carpal tunnel syndrome and assessment of risk factors. *J Occup Rehabil*, *15*(1), 47-55.
- Gellman, H. (2008). Compression of the ulnar nerve at the elbow: cubital tunnel syndrome. *Instr Course Lect*, *57*, 187-197.
- Gerritsen, A. A., de Vet, H. C., Scholten, R. J., Bertelsmann, F. W., de Krom, M. C., & Bouter, L. M. (2002). Splinting vs surgery in the treatment of carpal tunnel syndrome: a randomized controlled trial. *JAMA*, *288*(10), 1245-1251.
- Goetz. (2007). Examination of the position, touch, and vibratory sensory systems. *MD Consult*.
- Gonzalez, P., Laker, S. R., Sullivan, W., Harwood, J. E., & Akuthota, V. (2009). The effects of epidural betamethasone on blood glucose in patients with diabetes mellitus. *Pm r*, *1*(4), 340-345. doi:10.1016/j.pmrj.2008.12.007
- Gorsche, R., Wiley, J. P., Renger, R., Brant, R., Gemer, T. Y., & Sasyniuk, T. M. (1998). Prevalence and incidence of stenosing flexor tenosynovitis (trigger finger) in a meat-packing plant. *J Occup Environ Med*, *40*(6), 556-560.
- Gosens, T., Peerbooms, J. C., van Laar, W., & den Oudsten, B. L. (2011). Ongoing positive effect of platelet-rich plasma versus corticosteroid injection in lateral epicondylitis: a double-blind

- randomized controlled trial with 2-year follow-up. *Am J Sports Med*, 39(6), 1200-1208. doi:10.1177/0363546510397173
- Graham, J. B., Hulkower, S. D., Bosworth, M., White, E. L., & Gauer, R. (2007). Clinical inquiries. Are steroid injections effective for tenosynovitis of the hand? *J Fam Pract*, 56(12), 1045-1047.
- Gross, D. P., & Battie, M. C. (2004). The prognostic value of functional capacity evaluation in patients with chronic low back pain: part 2: sustained recovery. *Spine (Phila Pa 1976)*, 29(8), 920-924.
- Gross, D. P., Battie, M. C., & Asante, A. K. (2007). Evaluation of a short-form functional capacity evaluation: less may be best. *J Occup Rehabil*, 17(3), 422-435. doi:10.1007/s10926-007-9087-y
- Gross, D. P., Battie, M. C., & Cassidy, J. D. (2004). The prognostic value of functional capacity evaluation in patients with chronic low back pain: part 1: timely return to work. *Spine (Phila Pa 1976)*, 29(8), 914-919.
- Haahr, J. P., & Andersen, J. H. (2003). Physical and psychosocial risk factors for lateral epicondylitis: a population based case-referent study. *Occup Environ Med*, 60(5), 322-329.
- Habib, G. S., & Miari, W. (2011). The effect of intra-articular triamcinolone preparations on blood glucose levels in diabetic patients: a controlled study. *J Clin Rheumatol*, 17(6), 302-305. doi:10.1097/RHU.0b013e31822acd7c
- Hansen, P. A., Micklesen, P., & Robinson, L. R. (2004). Clinical utility of the flick maneuver in diagnosing carpal tunnel syndrome. *Am J Phys Med Rehabil*, 83(5), 363-367.
- Harris-Adamson, C., Eisen, E. A., Kapellusch, J., Garg, A., Hegmann, K. T., Thiese, M. S., . . . Rempel, D. (2015). Biomechanical risk factors for carpal tunnel syndrome: a pooled study of 2474 workers. *Occup Environ Med*, 72(1), 33-41. doi:10.1136/oemed-2014-102378
- Hazard, R. G., Spratt, K. F., McDonough, C. M., Carayannopoulos, A. G., Olson, C. M., Reeves, V., . . . Ossen, E. S. (2009). The impact of personal functional goal achievement on patient satisfaction with progress one year following completion of a functional restoration program for chronic disabling spinal disorders. *Spine (Phila Pa 1976)*, 34(25), 2797-2802. doi:10.1097/BRS.0b013e3181a9e640
- Hendrick, R. E., Dodd, G. D., 3rd, Fullerton, G. D., Hendee, W. R., Borgstede, J. P., & Larke, F. (2012). The University of Colorado Radiology Adult Dose-Risk Smartcard. *J Am Coll Radiol*, 9(4), 290-292. doi:10.1016/j.jacr.2011.12.034

- Hennig, T., Haehre, L., Hornburg, V. T., Mowinckel, P., Norli, E. S., & Kjekken, I. (2015). Effect of home-based hand exercises in women with hand osteoarthritis: a randomised controlled trial. *Ann Rheum Dis*, 74(8), 1501-1508. doi:10.1136/annrheumdis-2013-204808
- Henry, M., & Stutz, C. (2006). A unified approach to radial tunnel syndrome and lateral tendinosis. *Tech Hand Up Extrem Surg*, 10(4), 200-205. doi:10.1097/01.bth.0000231580.32406.71
- Heyworth, B. E., Lee, J. H., Kim, P. D., Lipton, C. B., Strauch, R. J., & Rosenwasser, M. P. (2008). Hylan versus corticosteroid versus placebo for treatment of basal joint arthritis: a prospective, randomized, double-blinded clinical trial. *J Hand Surg Am*, 33(1), 40-48. doi:10.1016/j.jhsa.2007.10.009
- Hlebs, S., Majhenic, K., & Vidmar, G. (2014). Body mass index and anthropometric characteristics of the hand as risk factors for carpal tunnel syndrome. *Coll Antropol*, 38(1), 219-226.
- Hoffman, B. M., Papas, R. K., Chatkoff, D. K., & Kerns, R. D. (2007). Meta-analysis of psychological interventions for chronic low back pain. *Health Psychol*, 26(1), 1-9. doi:10.1037/0278-6133.26.1.1
- Homan, M. M., & Armstrong, T. J. (2003). Evaluation of three methodologies for assessing work activity during computer use. *AIHA J (Fairfax, Va)*, 64(1), 48-55.
- Hoogvliet, P., Coert, J. H., Friden, J., & Huisstede, B. M. (2013). How to treat Guyon's canal syndrome? Results from the European HANDGUIDE study: a multidisciplinary treatment guideline. *Br J Sports Med*, 47(17), 1063-1070. doi:10.1136/bjsports-2013-092280
- Hooper, L., Brown, T. J., Elliott, R., Payne, K., Roberts, C., & Symmons, D. (2004). The effectiveness of five strategies for the prevention of gastrointestinal toxicity induced by non-steroidal anti-inflammatory drugs: systematic review. *BMJ*, 329(7472), 948. doi:10.1136/bmj.38232.680567.EB
- Hui, A. C., Wong, S., Leung, C. H., Tong, P., Mok, V., Poon, D., . . . Boet, R. (2005). A randomized controlled trial of surgery vs steroid injection for carpal tunnel syndrome. *Neurology*, 64(12), 2074-2078. doi:10.1212/01.WNL.0000169017.79374.93
- Huisstede, B., Miedema, H. S., van Opstal, T., de Ronde, M. T., Verhaar, J. A., & Koes, B. W. (2008). Interventions for treating the radial tunnel syndrome: a systematic review of observational studies. *J Hand Surg Am*, 33(1), 72-78. doi:10.1016/j.jhsa.2007.10.001



- Huisstede, B. M., Coert, J. H., Friden, J., & Hoogvliet, P. (2014). Consensus on a multidisciplinary treatment guideline for de Quervain disease: results from the European HANDGUIDE study. *Phys Ther*, *94*(8), 1095-1110. doi:10.2522/ptj.20130069
- Huisstede, B. M., Hoogvliet, P., Coert, J. H., & Friden, J. (2014). Multidisciplinary consensus guideline for managing trigger finger: results from the European HANDGUIDE Study. *Phys Ther*, *94*(10), 1421-1433. doi:10.2522/ptj.20130135
- Huisstede, B. M., Hoogvliet, P., Randsdorp, M. S., Glerum, S., van Middelkoop, M., & Koes, B. W. (2010). Carpal tunnel syndrome. Part I: effectiveness of nonsurgical treatments--a systematic review. *Arch Phys Med Rehabil*, *91*(7), 981-1004. doi:10.1016/j.apmr.2010.03.022
- Huisstede, B. M., Randsdorp, M. S., Coert, J. H., Glerum, S., van Middelkoop, M., & Koes, B. W. (2010). Carpal tunnel syndrome. Part II: effectiveness of surgical treatments--a systematic review. *Arch Phys Med Rehabil*, *91*(7), 1005-1024. doi:10.1016/j.apmr.2010.03.023
- Hutchison, R. L., & Rayan, G. (2011). Diagnosis of cubital tunnel syndrome. *J Hand Surg Am*, *36*(9), 1519-1521. doi:10.1016/j.jhsa.2011.03.021
- Ilyas, A. M. (2009). Nonsurgical treatment for de Quervain's tenosynovitis. *J Hand Surg Am*, *34*(5), 928-929. doi:10.1016/j.jhsa.2008.12.030
- Ilyas, A. M., Ast, M., Schaffer, A. A., & Thoder, J. (2007). De quervain tenosynovitis of the wrist. *J Am Acad Orthop Surg*, *15*(12), 757-764.
- Jahangiri, A., Moghaddam, F. R., & Najafi, S. (2014). Hypertonic dextrose versus corticosteroid local injection for the treatment of osteoarthritis in the first carpometacarpal joint: a double-blind randomized clinical trial. *J Orthop Sci*, *19*(5), 737-743. doi:10.1007/s00776-014-0587-2
- Jarvik, J. G., Comstock, B. A., Kliot, M., Turner, J. A., Chan, L., Heagerty, P. J., . . . Deyo, R. A. (2009). Surgery versus non-surgical therapy for carpal tunnel syndrome: a randomised parallel-group trial. *Lancet*, *374*(9695), 1074-1081. doi:10.1016/s0140-6736(09)61517-8
- Jeffcoach, D. R., Sams, V. G., Lawson, C. M., Enderson, B. L., Smith, S. T., Kline, H., . . . University of Tennessee Medical Center, D. o. S. (2014). Nonsteroidal anti-inflammatory drugs' impact on nonunion and infection rates in long-bone fractures. *J Trauma Acute Care Surg*, *76*(3), 779-783. doi:10.1097/TA.0b013e3182aafe0d
- Jensen, C. (2003). Development of neck and hand-wrist symptoms in relation to duration of computer use at work. *Scand J Work Environ Health*, *29*(3), 197-205.

- Jensen, C., Jensen, O. K., & Nielsen, C. V. (2012). Sustainability of return to work in sick-listed employees with low-back pain. Two-year follow-up in a randomized clinical trial comparing multidisciplinary and brief intervention. *BMC Musculoskelet Disord*, 13, 156. doi:10.1186/1471-2474-13-156
- Jones, T., Kelsberg, G., & Safranek, S. (2014). FPIN's clinical inquiries: Intra-articular corticosteroid injections for osteoarthritis of the knee. *Am Fam Physician*, 90(2), 115-116.
- Kang, H. J., Koh, I. H., Jang, J. W., & Choi, Y. R. (2013). Endoscopic versus open release in patients with de Quervain's tenosynovitis: a randomised trial. *Bone Joint J*, 95-b(7), 947-951. doi:10.1302/0301-620x.95b7.31486
- Kaplan, S. J., Glickel, S. Z., & Eaton, R. G. (1990). Predictive factors in the non-surgical treatment of carpal tunnel syndrome. *J Hand Surg Br*, 15(1), 106-108.
- Keir, P. J., Bach, J. M., Hudes, M., & Rempel, D. M. (2007). Guidelines for wrist posture based on carpal tunnel pressure thresholds. *Hum Factors*, 49(1), 88-99.
- Keir, P. J., Bach, J. M., & Rempel, D. (1999). Effects of computer mouse design and task on carpal tunnel pressure. *Ergonomics*, 42(10), 1350-1360. doi:10.1080/001401399184992
- Kendrick, D., Vinogradova, Y., Coupland, C., Christie, N., Lyons, R. A., Towner, E. L., & Group, U. K. B. o. I. S. (2012). Getting back to work after injury: the UK Burden of Injury multicentre longitudinal study. *BMC Public Health*, 12, 584. doi:10.1186/1471-2458-12-584
- Khan, N., Abbas, A., Williamson, A., & Balart, L. (2013). Prevalence of corticosteroids use and disease course after initial steroid exposure in ulcerative colitis. *Dig Dis Sci*, 58(10), 2963-2969. doi:10.1007/s10620-013-2748-0
- Khosrawi, S., & Maghrouri, R. (2012). The prevalence and severity of carpal tunnel syndrome during pregnancy. *Adv Biomed Res*, 1, 43. doi:10.4103/2277-9175.100143
- Kochar, M., & Dogra, A. (2002). Effectiveness of a Specific Physiotherapy Regimen on Patients with Tennis Elbow. *Physiotherapy*, 88(6), 333-341. doi:10.1016/S0031-9406(05)60746-8
- Kortlever, J. T., Janssen, S. J., van Berckel, M. M., Ring, D., & Vranceanu, A. M. (2015). What Is the Most Useful Questionnaire for Measurement of Coping Strategies in Response to Nociception? *Clin Orthop Relat Res*, 473(11), 3511-3518. doi:10.1007/s11999-015-4419-2

- Kucuksen, S., Yilmaz, H., Salli, A., & Ugurlu, H. (2013). Muscle energy technique versus corticosteroid injection for management of chronic lateral epicondylitis: randomized controlled trial with 1-year follow-up. *Arch Phys Med Rehabil*, *94*(11), 2068-2074. doi:10.1016/j.apmr.2013.05.022
- Kume, K., Amano, K., Yamada, S., Amano, K., Kuwaba, N., & Ohta, H. (2012). In de Quervain's with a separate EPB compartment, ultrasound-guided steroid injection is more effective than a clinical injection technique: a prospective open-label study. *J Hand Surg Eur Vol*, *37*(6), 523-527. doi:10.1177/1753193411427829
- Lamb, S. E., Hansen, Z., Lall, R., Castelnovo, E., Withers, E. J., Nichols, V., . . . Back Skills Training Trial, i. (2010). Group cognitive behavioural treatment for low-back pain in primary care: a randomised controlled trial and cost-effectiveness analysis. *Lancet*, *375*(9718), 916-923. doi:10.1016/S0140-6736(09)62164-4
- Lambeek, L. C., van Mechelen, W., Knol, D. L., Loisel, P., & Anema, J. R. (2010). Randomised controlled trial of integrated care to reduce disability from chronic low back pain in working and private life. *BMJ*, *340*, c1035. doi:10.1136/bmj.c1035
- Lansang, M. C., Farmer, T., & Kennedy, L. (2009). Diagnosing the unrecognized systemic absorption of intra-articular and epidural steroid injections. *Endocr Pract*, *15*(3), 225-228. doi:10.4158/EP.15.3.225
- Lanska, D. J. (2006). Functional weakness and sensory loss. *Semin Neurol*, *26*(3), 297-309. doi:10.1055/s-2006-945516
- Lassen, C. F., Mikkelsen, S., Kryger, A. I., Brandt, L. P., Overgaard, E., Thomsen, J. F., . . . Andersen, J. H. (2004). Elbow and wrist/hand symptoms among 6,943 computer operators: a 1-year follow-up study (the NUDATA study). *Am J Ind Med*, *46*(5), 521-533. doi:10.1002/ajim.20081
- Lavin, P. J., & Workman, R. (2001). Cushing syndrome induced by serial occipital nerve blocks containing corticosteroids. *Headache*, *41*(9), 902-904.
- Leclerc, A., Landre, M. F., Chastang, J. F., Niedhammer, I., Roquelaure, Y., & Study Group on Repetitive, W. (2001). Upper-limb disorders in repetitive work. *Scand J Work Environ Health*, *27*(4), 268-278.
- Lindson-Hawley, N., Banting, M., West, R., Michie, S., Shinkins, B., & Aveyard, P. (2016). Gradual Versus Abrupt Smoking Cessation: A Randomized, Controlled Noninferiority Trial. *Ann Intern Med*, *164*(9), 585-592. doi:10.7326/M14-2805

- Linton, S. J., Boersma, K., Jansson, M., Svard, L., & Botvalde, M. (2005). The effects of cognitive-behavioral and physical therapy preventive interventions on pain-related sick leave: a randomized controlled trial. *Clin J Pain, 21*(2), 109-119.
- Loew, L. M., Brosseau, L., Tugwell, P., Wells, G. A., Welch, V., Shea, B., . . . Rahman, P. (2014). Deep transverse friction massage for treating lateral elbow or lateral knee tendinitis. *Cochrane Database Syst Rev*(11), Cd003528. doi:10.1002/14651858.CD003528.pub2
- Macadam, S. A., Gandhi, R., Bezuhyly, M., & Lefavre, K. A. (2008). Simple decompression versus anterior subcutaneous and submuscular transposition of the ulnar nerve for cubital tunnel syndrome: a meta-analysis. *J Hand Surg Am, 33*(8), 1314 e1311-1312. doi:10.1016/j.jhsa.2008.03.006
- Macfarlane, G. J., Hunt, I. M., & Silman, A. J. (2000). Role of mechanical and psychosocial factors in the onset of forearm pain: prospective population based study. *BMJ, 321*(7262), 676-679.
- Mahmud, N., Schonstein, E., Schaafsma, F., Lehtola, M. M., Fassier, J. B., Verbeek, J. H., & Reneman, M. F. (2010). Functional capacity evaluations for the prevention of occupational re-injuries in injured workers. *Cochrane Database Syst Rev*(7), CD007290. doi:10.1002/14651858.CD007290.pub2
- Makanji, H. S., Becker, S. J., Mudgal, C. S., Jupiter, J. B., & Ring, D. (2014). Evaluation of the scratch collapse test for the diagnosis of carpal tunnel syndrome. *J Hand Surg Eur Vol, 39*(2), 181-186. doi:10.1177/1753193413497191
- Mandl, L., Wolfe, S., Daluiski, A., Hotchkiss, R. N., Lyman, S. L., & Katz, J. N. (2012). A Randomized Controlled Trial of Hylan G-F 20 for the Treatment of Carpometacarpal Osteoarthritis. *Arthritis & Rheumatism, 64*(10), S475 - S476.
- Mardani-Kivi, M., Karimi-Mobarakeh, M., Karimi, A., Akhoondzadeh, N., Saheb-Ekhtiari, K., Hashemi-Motlagh, K., & Bahrami, F. (2013). The effects of corticosteroid injection versus local anesthetic injection in the treatment of lateral epicondylitis: a randomized single-blinded clinical trial. *Arch Orthop Trauma Surg, 133*(6), 757-763. doi:10.1007/s00402-013-1721-x
- Mardani-Kivi, M., Karimi Mobarakeh, M., Bahrami, F., Hashemi-Motlagh, K., Saheb-Ekhtiari, K., & Akhoondzadeh, N. (2014). Corticosteroid injection with or without thumb spica cast for de Quervain tenosynovitis. *J Hand Surg Am, 39*(1), 37-41. doi:10.1016/j.jhsa.2013.10.013
- Martou, G., Veltri, K., & Thoma, A. (2004). Surgical treatment of osteoarthritis of the carpometacarpal joint of the thumb: a systematic review. *Plast Reconstr Surg, 114*(2), 421-432.

- Massey, T., Derry, S., Moore, R. A., & McQuay, H. J. (2010). Topical NSAIDs for acute pain in adults. *Cochrane Database Syst Rev*(6), CD007402. doi:10.1002/14651858.CD007402.pub2
- Matheson, L. N., Isernhagen, S. J., & Hart, D. L. (2002). Relationships among lifting ability, grip force, and return to work. *Phys Ther*, *82*(3), 249-256.
- Mattioli, S., Baldasseroni, A., Bovenzi, M., Curti, S., Cooke, R. M., Campo, G., . . . Violante, F. S. (2009). Risk factors for operated carpal tunnel syndrome: a multicenter population-based case-control study. *BMC Public Health*, *9*, 343. doi:10.1186/1471-2458-9-343
- Mazieres, B., Rouanet, S., Guillon, Y., Scarsi, C., & Reiner, V. (2005). Topical ketoprofen patch in the treatment of tendinitis: a randomized, double blind, placebo controlled study. *J Rheumatol*, *32*(8), 1563-1570.
- McAtamney, L., & Nigel Corlett, E. (1993). RULA: a survey method for the investigation of work-related upper limb disorders. *Appl Ergon*, *24*(2), 91-99.
- Mediouni, Z., de Roquemaurel, A., Dumontier, C., Becour, B., Garrabe, H., Roquelaure, Y., & Descatha, A. (2014). Is carpal tunnel syndrome related to computer exposure at work? A review and meta-analysis. *J Occup Environ Med*, *56*(2), 204-208. doi:10.1097/jom.0000000000000080
- Mikkelsen, S., Vilstrup, I., Lassen, C. F., Kryger, A. I., Thomsen, J. F., & Andersen, J. H. (2007). Validity of questionnaire self-reports on computer, mouse and keyboard usage during a four-week period. *Occup Environ Med*, *64*(8), 541-547. doi:10.1136/oem.2005.026351
- Moghtaderi, A., Bakhshipour, A., & Rashidi, H. (2006). Validation of Michigan neuropathy screening instrument for diabetic peripheral neuropathy. *Clin Neurol Neurosurg*, *108*(5), 477-481. doi:10.1016/j.clineuro.2005.08.003
- Monfort, J., Rotes-Sala, D., Segales, N., Montanes, F. J., Orellana, C., Llorente-Onaindia, J., . . . Benito, P. (2015). Comparative efficacy of intra-articular hyaluronic acid and corticoid injections in osteoarthritis of the first carpometacarpal joint: results of a 6-month single-masked randomized study. *Joint Bone Spine*, *82*(2), 116-121. doi:10.1016/j.jbspin.2014.08.008
- Moon, H. J., Choi, K. H., Lee, S. I., Lee, O. J., Shin, J. W., & Kim, T. W. (2014). Changes in blood glucose and cortisol levels after epidural or shoulder intra-articular glucocorticoid injections in diabetic or nondiabetic patients. *Am J Phys Med Rehabil*, *93*(5), 372-378. doi:10.1097/PHM.0000000000000001

- Moraes, V. Y., Lenza, M., Tamaoki, M. J., Faloppa, F., & Belloti, J. C. (2013). Platelet-rich therapies for musculoskeletal soft tissue injuries. *Cochrane Database Syst Rev*(12), Cd010071. doi:10.1002/14651858.CD010071.pub2
- Nabhan, A., Steudel, W. I., Dedeman, L., Al-Khayat, J., & Ishak, B. (2011). Subcutaneous local anesthesia versus intravenous regional anesthesia for endoscopic carpal tunnel release: a randomized controlled trial. *J Neurosurg*, 114(1), 240-244. doi:10.3171/2008.2.17395
- Nagrale, A. V., Herd, C. R., Ganvir, S., & Ramteke, G. (2009). Cyriax physiotherapy versus phonophoresis with supervised exercise in subjects with lateral epicondylalgia: a randomized clinical trial. *J Man Manip Ther*, 17(3), 171-178. doi:10.1179/jmt.2009.17.3.171
- Nalamachu, S., Crockett, R. S., Gammaitoni, A. R., & Gould, E. M. (2006). A comparison of the lidocaine patch 5% vs naproxen 500 mg twice daily for the relief of pain associated with carpal tunnel syndrome: a 6-week, randomized, parallel-group study. *MedGenMed*, 8(3), 33.
- Nalamachu, S., Crockett, R. S., & Mathur, D. (2006). Lidocaine patch 5 for carpal tunnel syndrome: how it compares with injections: a pilot study. *J Fam Pract*, 55(3), 209-214.
- National Institute of Occupational Safety and Health [NIOSH]. (1997). Musculoskeletal disorders and workplace factors. A critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. *NIOSH Publication*, 91-141.
- Newcomer, K. L., Vickers Douglas, K. S., Shelerud, R. A., Long, K. H., & Crawford, B. (2008). Is a videotape to change beliefs and behaviors superior to a standard videotape in acute low back pain? A randomized controlled trial. *Spine J*, 8(6), 940-947. doi:10.1016/j.spinee.2007.08.007
- Nirschl, R. P., Rodin, D. M., Ochiai, D. H., Maartmann-Moe, C., & Group, D.-A.-S. (2003). Iontophoretic administration of dexamethasone sodium phosphate for acute epicondylitis. A randomized, double-blinded, placebo-controlled study. *Am J Sports Med*, 31(2), 189-195.
- Nordstrom, D. L., Vierkant, R. A., DeStefano, F., & Layde, P. M. (1997). Risk factors for carpal tunnel syndrome in a general population. *Occup Environ Med*, 54(10), 734-740.
- Novak, C. B., Lee, G. W., Mackinnon, S. E., & Lay, L. (1994). Provocative testing for cubital tunnel syndrome. *J Hand Surg Am*, 19(5), 817-820. doi:10.1016/0363-5023(94)90193-7
- O'Connor, D., Marshall, S., & Massy-Westropp, N. (2003). Non-surgical treatment (other than steroid injection) for carpal tunnel syndrome. *Cochrane Database Syst Rev*(1), CD003219. doi:10.1002/14651858.CD003219

- O'Connor, D., Page, M. J., Marshall, S. C., & Massy-Westropp, N. (2012). Ergonomic positioning or equipment for treating carpal tunnel syndrome. *Cochrane Database Syst Rev*, 1, Cd009600. doi:10.1002/14651858.cd009600
- Occupational Safety & Health Service (OSHA). (1988). Retrieved from <http://www.osha.gov/Publications/videoDisplay/videoDisplay.html>
- Oesch, P., Kool, J., Hagen, K. B., & Bachmann, S. (2010). Effectiveness of exercise on work disability in patients with non-acute non-specific low back pain: Systematic review and meta-analysis of randomised controlled trials. *J Rehabil Med*, 42(3), 193-205. doi:10.2340/16501977-0524
- Ono, Y., Nakamura, R., Shimaoka, M., Hiruta, S., Hattori, Y., Ichihara, G., . . . Takeuchi, Y. (1998). Epicondylitis among cooks in nursery schools. *Occup Environ Med*, 55(3), 172-179. doi:10.1136/oem.55.3.172
- Ortiz-Corredor, F., Enriquez, F., Diaz-Ruiz, J., & Calambas, N. (2008). Natural evolution of carpal tunnel syndrome in untreated patients. *Clin Neurophysiol*, 119(6), 1373-1378. doi:10.1016/j.clinph.2008.02.012
- Ostergaard, M., & Halberg, P. (1998). Intra-articular corticosteroids in arthritic disease: a guide to treatment. *BioDrugs*, 9(2), 95-103.
- Ozden, R., Uruc, V., Dogramaci, Y., Kalaci, A., & Yengil, E. (2014). Management of tennis elbow with topical glyceryl trinitrate. *Acta Orthop Traumatol Turc*, 48(2), 175-180. doi:10.3944/aott.2014.3123
- Ozturan, K. E., Yucel, I., Cakici, H., Guven, M., & Sungur, I. (2010). Autologous blood and corticosteroid injection and extracorporeal shock wave therapy in the treatment of lateral epicondylitis. *Orthopedics*, 33(2), 84-91. doi:10.3928/01477447-20100104-09
- Padua, L., Padua, R., Aprile, I., Pasqualetti, P., Tonali, P., & Italian, C. T. S. S. G. C. t. s. (2001). Multiperspective follow-up of untreated carpal tunnel syndrome: a multicenter study. *Neurology*, 56(11), 1459-1466.
- Page, M. J., O'Connor, D., Pitt, V., & Massy-Westropp, N. (2012). Exercise and mobilisation interventions for carpal tunnel syndrome. *Cochrane Database Syst Rev*(6), Cd009899. doi:10.1002/14651858.cd009899

- Page, M. J., O'Connor, D., Pitt, V., & Massy-Westropp, N. (2013). Therapeutic ultrasound for carpal tunnel syndrome. *Cochrane Database Syst Rev*(3), Cd009601. doi:10.1002/14651858.CD009601.pub2
- Palmer, K. T., Harris, E. C., & Coggon, D. (2007). Carpal tunnel syndrome and its relation to occupation: a systematic literature review. *Occup Med (Lond)*, 57(1), 57-66. doi:10.1093/occmed/kql125
- Paoloni, J. A., Murrell, G. A., Burch, R. M., & Ang, R. Y. (2009). Randomised, double-blind, placebo-controlled clinical trial of a new topical glyceryl trinitrate patch for chronic lateral epicondylitis. *Br J Sports Med*, 43(4), 299-302. doi:10.1136/bjsm.2008.053108
- Pattanittum, P., Turner, T., Green, S., & Buchbinder, R. (2013). Non-steroidal anti-inflammatory drugs (NSAIDs) for treating lateral elbow pain in adults. *Cochrane Database Syst Rev*(5), CD003686. doi:10.1002/14651858.CD003686.pub2
- Peerbooms, J. C., Sluimer, J., Bruijn, D. J., & Gosens, T. (2010). Positive effect of an autologous platelet concentrate in lateral epicondylitis in a double-blind randomized controlled trial: platelet-rich plasma versus corticosteroid injection with a 1-year follow-up. *Am J Sports Med*, 38(2), 255-262. doi:10.1177/0363546509355445
- Peters-Veluthamaningal, C., van der Windt, D. A., Winters, J. C., & Meyboom-de Jong, B. (2009). Corticosteroid injection for de Quervain's tenosynovitis. *Cochrane Database Syst Rev*(3), Cd005616. doi:10.1002/14651858.CD005616.pub2
- Peters-Veluthamaningal, C., Winters, J. C., Groenier, K. H., & Meyboom-de Jong, B. (2010). Randomised controlled trial of local corticosteroid injections for carpal tunnel syndrome in general practice. *BMC Fam Pract*, 11, 54. doi:10.1186/1471-2296-11-54
- Peters, S., Page, M. J., Coppieters, M. W., Ross, M., & Johnston, V. (2013). Rehabilitation following carpal tunnel release. *Cochrane Database Syst Rev*(6), Cd004158. doi:10.1002/14651858.CD004158.pub2
- Placzek, R., Drescher, W., Deuretzbacher, G., Hempfing, A., & Meiss, A. L. (2007). Treatment of chronic radial epicondylitis with botulinum toxin A. A double-blind, placebo-controlled, randomized multicenter study. *J Bone Joint Surg Am*, 89(2), 255-260. doi:10.2106/JBJS.F.00401



- Plastino, M., Fava, A., Carmela, C., De Bartolo, M., Ermio, C., Cristiano, D., . . . Bosco, D. (2011). Insulin resistance increases risk of carpal tunnel syndrome: a case-control study. *J Peripher Nerv Syst*, 16(3), 186-190. doi:10.1111/j.1529-8027.2011.00344.x
- Pomerance, J., & Fine, I. (2007). Outcomes of carpal tunnel surgery with and without supervised postoperative therapy. *J Hand Surg Am*, 32(8), 1159-1163; discussion 1164-1155. doi:10.1016/j.jhsa.2007.05.001
- Pomerance, J., Zurakowski, D., & Fine, I. (2009). The cost-effectiveness of nonsurgical versus surgical treatment for carpal tunnel syndrome. *J Hand Surg Am*, 34(7), 1193-1200. doi:10.1016/j.jhsa.2009.04.034
- Pope, D. P., Silman, A. J., Cherry, N. M., Pritchard, C., & Macfarlane, G. J. (1998). Validity of a self-completed questionnaire measuring the physical demands of work. *Scand J Work Environ Health*, 24(5), 376-385.
- Pourmemari, M. H., & Shiri, R. (2016). Diabetes as a risk factor for carpal tunnel syndrome: a systematic review and meta-analysis. *Diabet Med*, 33(1), 10-16. doi:10.1111/dme.12855
- Prosser, R., Hancock, M. J., Nicholson, L., Merry, C., Thorley, F., & Wheen, D. (2014). Rigid versus semi-rigid orthotic use following TMC arthroplasty: a randomized controlled trial. *J Hand Ther*, 27(4), 265-270; quiz 271. doi:10.1016/j.jht.2014.06.002
- Punnett, L. (1998). Ergonomic stressors and upper extremity disorders in vehicle manufacturing: cross sectional exposure-response trends. *Occup Environ Med*, 55(6), 414-420.
- Punnett, L., Gold, J., Katz, J. N., Gore, R., & Wegman, D. H. (2004). Ergonomic stressors and upper extremity musculoskeletal disorders in automobile manufacturing: a one year follow up study. *Occup Environ Med*, 61(8), 668-674. doi:10.1136/oem.2003.008979
- Rabago, D., Best, T. M., Zgierska, A. E., Zeisig, E., Ryan, M., & Crane, D. (2009). A systematic review of four injection therapies for lateral epicondylitis: prolotherapy, polidocanol, whole blood and platelet-rich plasma. *Br J Sports Med*, 43(7), 471-481. doi:10.1136/bjism.2008.052761
- Ramchurn, N., Mashamba, C., Leitch, E., Arutchelvam, V., Narayanan, K., Weaver, J., . . . Kelly, C. (2009). Upper limb musculoskeletal abnormalities and poor metabolic control in diabetes. *Eur J Intern Med*, 20(7), 718-721. doi:10.1016/j.ejim.2009.08.001
- Rannou, F., Dimet, J., Boutron, I., Baron, G., Fayad, F., Mace, Y., . . . Poiradeau, S. (2009). Splint for base-of-thumb osteoarthritis: a randomized trial. *Ann Intern Med*, 150(10), 661-669.

- Rempel, D. M., Keir, P. J., & Bach, J. M. (2008). Effect of wrist posture on carpal tunnel pressure while typing. *J Orthop Res*, 26(9), 1269-1273. doi:10.1002/jor.20599
- Ritting, A. W., Leger, R., O'Malley, M. P., Mogielnicki, H., Tucker, R., & Rodner, C. M. (2012). Duration of postoperative dressing after mini-open carpal tunnel release: a prospective, randomized trial. *J Hand Surg Am*, 37(1), 3-8. doi:10.1016/j.jhsa.2011.10.011
- Rompe, J. D. (2004). Repetitive Low-Energy Shock Wave Treatment for Chronic Lateral Epicondylitis in Tennis Players. *American Journal of Sports Medicine*, 32(3), 734-743. doi:10.1177/0363546503261697
- Roquelaure, Y., Ha, C., Leclerc, A., Touranchet, A., Sauteron, M., Melchior, M., . . . Goldberg, M. (2006). Epidemiologic surveillance of upper-extremity musculoskeletal disorders in the working population. *Arthritis Rheum*, 55(5), 765-778. doi:10.1002/art.22222
- Roquelaure, Y., Ha, C., Rouillon, C., Fouquet, N., Leclerc, A., Descatha, A., . . . Members of Occupational Health Services of the Pays de la Loire, R. (2009). Risk factors for upper-extremity musculoskeletal disorders in the working population. *Arthritis Rheum*, 61(10), 1425-1434. doi:10.1002/art.24740
- Roquelaure, Y., Mariel, J., Dano, C., Fanello, S., & Penneau-Fontbonne, D. (2001). Prevalence, incidence and risk factors of carpal tunnel syndrome in a large footwear factory. *Int J Occup Med Environ Health*, 14(4), 357-367.
- Roquelaure, Y., Mariel, J., Fanello, S., Boissiere, J. C., Chiron, H., Dano, C., . . . Penneau-Fontbonne, D. (2002). Active epidemiological surveillance of musculoskeletal disorders in a shoe factory. *Occup Environ Med*, 59(7), 452-458.
- Roquelaure, Y., Mechali, S., Dano, C., Fanello, S., Benetti, F., Bureau, D., . . . Penneau-Fontbonne, D. (1997). Occupational and personal risk factors for carpal tunnel syndrome in industrial workers. *Scand J Work Environ Health*, 23(5), 364-369.
- Roquelaure, Y., Raimbeau, G., Dano, C., Martin, Y. H., Pelier-Cady, M. C., Mechali, S., . . . Penneau-Fontbonne, D. (2000). Occupational risk factors for radial tunnel syndrome in industrial workers. *Scand J Work Environ Health*, 26(6), 507-513.
- Roux, C., Fontas, E., Breuil, V., Brocq, O., Albert, C., & Euller-Ziegler, L. (2007). Injection of intra-articular sodium hyaluronidate (Sinovial) into the carpometacarpal joint of the thumb (CMC1) in osteoarthritis. A prospective evaluation of efficacy. *Joint Bone Spine*, 74(4), 368-372. doi:10.1016/j.jbspin.2006.08.008

- Salem, H. M., & Davis, T. R. (2014). Degenerative change at the pseudarthrosis after trapeziectomy at 6-year followup. *Clin Orthop Relat Res*, 472(4), 1160-1165. doi:10.1007/s11999-013-2956-0
- Sandin, K. J., Asch, S. M., Jablecki, C. K., Kilmer, D. D., & Nuckols, T. K. (2010). Clinical quality measures for electrodiagnosis in suspected carpal tunnel syndrome. *Muscle Nerve*, 41(4), 444-452. doi:10.1002/mus.21617
- Schmid, A. B., Kubler, P. A., Johnston, V., & Coppieters, M. W. (2015). A vertical mouse and ergonomic mouse pads alter wrist position but do not reduce carpal tunnel pressure in patients with carpal tunnel syndrome. *Appl Ergon*, 47, 151-156. doi:10.1016/j.apergo.2014.08.020
- Scholz, J., Mannion, R. J., Hord, D. E., Griffin, R. S., Rawal, B., Zheng, H., . . . Woolf, C. J. (2009). A novel tool for the assessment of pain: validation in low back pain. *PLoS Med*, 6(4), e1000047. doi:10.1371/journal.pmed.1000047
- Schrijver, H. M., Gerritsen, A. A., Strijers, R. L., Uitdehaag, B. M., Scholten, R. J., de Vet, H. C., & Bouter, L. M. (2005). Correlating nerve conduction studies and clinical outcome measures on carpal tunnel syndrome: lessons from a randomized controlled trial. *J Clin Neurophysiol*, 22(3), 216-221.
- Schwartz, C. E., & Finkelstein, J. A. (2009). Understanding inconsistencies in patient-reported outcomes after spine treatment: response shift phenomena. *Spine J*, 9(12), 1039-1045. doi:10.1016/j.spinee.2009.05.010
- Shakeel, H., & Ahmad, T. S. (2012). Steroid injection versus NSAID injection for trigger finger: a comparative study of early outcomes. *J Hand Surg Am*, 37(7), 1319-1323. doi:10.1016/j.jhsa.2012.03.040
- Shi, Q., & MacDermid, J. C. (2011). Is surgical intervention more effective than non-surgical treatment for carpal tunnel syndrome? A systematic review. *J Orthop Surg Res*, 6, 17. doi:10.1186/1749-799x-6-17
- Shi, Q., MacDermid, J. C., Santaguida, P. L., & Kyu, H. H. (2011). Predictors of surgical outcomes following anterior transposition of ulnar nerve for cubital tunnel syndrome: a systematic review. *J Hand Surg Am*, 36(12), 1996-2001. doi:10.1016/j.jhsa.2011.09.024
- Shilling, A. M., & Raphael, J. (2008). Diabetes, hyperglycemia, and infections. *Best Pract Res Clin Anaesthesiol*, 22(3), 519-535.

- Shin, E. K., & Osterman, A. L. (2008). Treatment of thumb metacarpophalangeal and interphalangeal joint arthritis. *Hand Clin*, 24(3), 239-250. doi:10.1016/j.hcl.2008.03.007
- Shiri, R. (2014). Hypothyroidism and carpal tunnel syndrome: a meta-analysis. *Muscle Nerve*, 50(6), 879-883. doi:10.1002/mus.24453
- Shiri, R. (2015). A square-shaped wrist as a predictor of carpal tunnel syndrome: A meta-analysis. *Muscle Nerve*, 52(5), 709-713. doi:10.1002/mus.24761
- Shiri, R., Miranda, H., Heliovaara, M., & Viikari-Juntura, E. (2009). Physical work load factors and carpal tunnel syndrome: a population-based study. *Occup Environ Med*, 66(6), 368-373. doi:10.1136/oem.2008.039719
- Shiri, R., Pourmemari, M. H., Falah-Hassani, K., & Viikari-Juntura, E. (2015). The effect of excess body mass on the risk of carpal tunnel syndrome: a meta-analysis of 58 studies. *Obes Rev*, 16(12), 1094-1104. doi:10.1111/obr.12324
- Shiri, R., Viikari-Juntura, E., Varonen, H., & Heliovaara, M. (2006). Prevalence and determinants of lateral and medial epicondylitis: a population study. *Am J Epidemiol*, 164(11), 1065-1074. doi:10.1093/aje/kwj325
- Silverstein, B. A., Fine, L. J., & Armstrong, T. J. (1987). Occupational factors and carpal tunnel syndrome. *Am J Ind Med*, 11(3), 343-358.
- Smidt, N., van der Windt, D. A., Assendelft, W. J., Deville, W. L., Korthals-de Bos, I. B., & Bouter, L. M. (2002). Corticosteroid injections, physiotherapy, or a wait-and-see policy for lateral epicondylitis: a randomised controlled trial. *Lancet*, 359(9307), 657-662. doi:10.1016/S0140-6736(02)07811-X
- Smith, T. O., Drew, B., Toms, A. P., Jerosch-Herold, C., & Chojnowski, A. J. (2012). Diagnostic accuracy of magnetic resonance imaging and magnetic resonance arthrography for triangular fibrocartilaginous complex injury: a systematic review and meta-analysis. *J Bone Joint Surg Am*, 94(9), 824-832. doi:10.2106/jbjs.j.01775
- Soderberg, J., Grooten, W. J., & Ang, B. O. (2012). Effects of eccentric training on hand strength in subjects with lateral epicondylalgia: a randomized-controlled trial. *Scand J Med Sci Sports*, 22(6), 797-803. doi:10.1111/j.1600-0838.2011.01317.x
- Song, J. W., Chung, K. C., & Prosser, L. A. (2012). Treatment of ulnar neuropathy at the elbow: cost-utility analysis. *J Hand Surg Am*, 37(8), 1617-1629. doi:10.1016/j.jhsa.2012.05.012

- Spaans, A. J., van Minnen, L. P., Kon, M., Schuurman, A. H., Schreuders, A. R., & Vermeulen, G. M. (2015). Conservative treatment of thumb base osteoarthritis: a systematic review. *J Hand Surg Am*, 40(1), 16-21.e11-16. doi:10.1016/j.jhsa.2014.08.047
- Spacca, G., Necozone, S., & Cacchio, A. (2005). Radial shock wave therapy for lateral epicondylitis: a prospective randomised controlled single-blind study. *Eura Medicophys*, 41(1), 17-25.
- Staal, J. B., de Bie, R., de Vet, H. C., Hildebrandt, J., & Nelemans, P. (2008). Injection therapy for subacute and chronic low-back pain. *Cochrane Database Syst Rev*(3), CD001824. doi:10.1002/14651858.CD001824.pub3
- Stahl, S., Karsh-Zafir, I., Ratzon, N., & Rosenberg, N. (2005). Comparison of intraarticular injection of depot corticosteroid and hyaluronic acid for treatment of degenerative trapeziometacarpal joints. *J Clin Rheumatol*, 11(6), 299-302.
- Stanley, J. (2006). Radial tunnel syndrome: a surgeon's perspective. *J Hand Ther*, 19(2), 180-184. doi:10.1197/j.jht.2006.02.005
- Stevens, J. C., Witt, J. C., Smith, B. E., & Weaver, A. L. (2001). The frequency of carpal tunnel syndrome in computer users at a medical facility. *Neurology*, 56(11), 1568-1570.
- Storheim, K., Brox, J. I., Holm, I., Koller, A. K., & Bo, K. (2003). Intensive group training versus cognitive intervention in sub-acute low back pain: short-term results of a single-blind randomized controlled trial. *J Rehabil Med*, 35(3), 132-140.
- Streibelt, M., Blume, C., Thren, K., Reneman, M. F., & Mueller-Fahrnow, W. (2009). Value of functional capacity evaluation information in a clinical setting for predicting return to work. *Arch Phys Med Rehabil*, 90(3), 429-434. doi:10.1016/j.apmr.2008.08.218
- Struijs, P. A., Smidt, N., Arola, H., Dijk v, C., Buchbinder, R., & Assendelft, W. J. (2002). Orthotic devices for the treatment of tennis elbow. *Cochrane Database Syst Rev*(1), CD001821. doi:10.1002/14651858.CD001821
- Sucher, B. M., & Schreiber, A. L. (2014). Carpal tunnel syndrome diagnosis. *Phys Med Rehabil Clin N Am*, 25(2), 229-247. doi:10.1016/j.pmr.2014.01.004
- Svernlöv, B., Larsson, M., Rehn, K., & Adolfsson, L. (2009). Conservative treatment of the cubital tunnel syndrome. *J Hand Surg Eur Vol*, 34(2), 201-207. doi:10.1177/1753193408098480

- Szabo, R. M. (2007). Distal radioulnar joint instability. *Instr Course Lect*, 56, 79-89.
- Tanaka, S., Petersen, M., & Cameron, L. (2001). Prevalence and risk factors of tendinitis and related disorders of the distal upper extremity among U.S. workers: comparison to carpal tunnel syndrome. *Am J Ind Med*, 39(3), 328-335.
- Tascioglu, F., Degirmenci, N. A., Ozkan, S., & Mehmetoglu, O. (2012). Low-level laser in the treatment of carpal tunnel syndrome: clinical, electrophysiological, and ultrasonographical evaluation. *Rheumatol Int*, 32(2), 409-415. doi:10.1007/s00296-010-1652-6
- Thomsen, J. F., Gerr, F., & Atroshi, I. (2008). Carpal tunnel syndrome and the use of computer mouse and keyboard: a systematic review. *BMC Musculoskelet Disord*, 9, 134. doi:10.1186/1471-2474-9-134
- Thorn, B. (2004). Cognitive Therapy for Chronic Pain. *National Register of Health Service Psychologists*.
- Treating tobacco use and dependence: 2008 update U.S. Public Health Service Clinical Practice Guideline executive summary. (2008). *Respir Care*, 53(9), 1217-1222.
- Tsai, P., & Beredjiklian, P. K. (2008). Physical diagnosis and radiographic examination of the thumb. *Hand Clin*, 24(3), 231-237, v. doi:10.1016/j.hcl.2008.03.004
- Van Heest, A. E., & Kallemeier, P. (2008). Thumb carpal metacarpal arthritis. *J Am Acad Orthop Surg*, 16(3), 140-151.
- Vasiliadis, H. S., Georgoulas, P., Shrier, I., Salanti, G., & Scholten, R. J. (2014). Endoscopic release for carpal tunnel syndrome. *Cochrane Database Syst Rev*(1), Cd008265. doi:10.1002/14651858.CD008265.pub2
- Wajon, A., Vinycomb, T., Carr, E., Edmunds, I., & Ada, L. (2015). Surgery for thumb (trapeziometacarpal joint) osteoarthritis. *Cochrane Database Syst Rev*(2), Cd004631. doi:10.1002/14651858.CD004631.pub4
- Walker-Bone, K., & Cooper, C. (2005). Hard work never hurt anyone: or did it? A review of occupational associations with soft tissue musculoskeletal disorders of the neck and upper limb. *Ann Rheum Dis*, 64(10), 1391-1396. doi:10.1136/ard.2003.020016

- Walker-Bone, K., Reading, I., Coggon, D., Cooper, C., & Palmer, K. T. (2006). Risk factors for specific upper limb disorders as compared with non-specific upper limb pain: assessing the utility of a structured examination schedule. *Occup Med (Lond)*, *56*(4), 243-250. doi:10.1093/occmed/kql016
- Wang, J., Zhao, J. G., & Liang, C. C. (2013). Percutaneous release, open surgery, or corticosteroid injection, which is the best treatment method for trigger digits? *Clin Orthop Relat Res*, *471*(6), 1879-1886. doi:10.1007/s11999-012-2716-6
- Ward, A., Watson, J., Wood, P., Dunne, C., & Kerr, D. (2002). Glucocorticoid epidural for sciatica: metabolic and endocrine sequelae. *Rheumatology (Oxford)*, *41*(1), 68-71.
- Washington State Department of Labor and Industries. (2009). Work-related proximal median nerve entrapment (PMNE): Diagnosis and treatment. Retrieved from <http://www.lni.wa.gov/ClaimsIns/Files/OMD/MedTreat/ProximalMedianNerve.pdf>.
- Weiss, A. P., Kamal, R. N., & Shultz, P. (2013). Total wrist arthroplasty. *J Am Acad Orthop Surg*, *21*(3), 140-148. doi:10.5435/jaaos-21-03-140
- Werner, R. A., & Andary, M. (2011). Electrodiagnostic evaluation of carpal tunnel syndrome. *Muscle Nerve*, *44*(4), 597-607. doi:10.1002/mus.22208
- Werner, R. A., Franzblau, A., Gell, N., Hartigan, A. G., Ebersole, M., & Armstrong, T. J. (2005). Incidence of carpal tunnel syndrome among automobile assembly workers and assessment of risk factors. *J Occup Environ Med*, *47*(10), 1044-1050.
- Werner, R. A., Franzblau, A., Gell, N., Ulin, S. S., & Armstrong, T. J. (2005a). A longitudinal study of industrial and clerical workers: predictors of upper extremity tendonitis. *J Occup Rehabil*, *15*(1), 37-46.
- Werner, R. A., Franzblau, A., Gell, N., Ulin, S. S., & Armstrong, T. J. (2005b). Predictors of upper extremity discomfort: a longitudinal study of industrial and clerical workers. *J Occup Rehabil*, *15*(1), 27-35.
- Werner, R. A., Hamann, C., Franzblau, A., & Rodgers, P. A. (2002). Prevalence of carpal tunnel syndrome and upper extremity tendinitis among dental hygienists. *J Dent Hyg*, *76*(2), 126-132.
- Wolf, J. M. (2008). Treatment of scaphotrapezio-trapezoid arthritis. *Hand Clin*, *24*(3), 301-306, vii. doi:10.1016/j.hcl.2008.03.002

- Wong, S. M., Hui, A. C., Tang, A., Ho, P. C., Hung, L. K., Wong, K. S., . . . Li, E. (2001). Local vs systemic corticosteroids in the treatment of carpal tunnel syndrome. *Neurology*, *56*(11), 1565-1567.
- Wong, S. M., Hui, A. C., Tong, P. Y., Poon, D. W., Yu, E., & Wong, L. K. (2005). Treatment of lateral epicondylitis with botulinum toxin: a randomized, double-blind, placebo-controlled trial. *Ann Intern Med*, *143*(11), 793-797.
- Yagci, I., Elmas, O., Akcan, E., Ustun, I., Gunduz, O. H., & Guven, Z. (2009). Comparison of splinting and splinting plus low-level laser therapy in idiopathic carpal tunnel syndrome. *Clin Rheumatol*, *28*(9), 1059-1065. doi:10.1007/s10067-009-1213-0
- Yao, E., Gerritz, P. K., Henricson, E., Abresch, T., Kim, J., Han, J., . . . Zhao, H. (2012). Randomized controlled trial comparing acupuncture with placebo acupuncture for the treatment of carpal tunnel syndrome. *Pm r*, *4*(5), 367-373. doi:10.1016/j.pmrj.2012.01.008
- Yao, J., & Park, M. J. (2008). Early treatment of degenerative arthritis of the thumb carpometacarpal joint. *Hand Clin*, *24*(3), 251-261, v-vi. doi:10.1016/j.hcl.2008.03.001
- Yildiz, N., Atalay, N. S., Gungen, G. O., Sanal, E., Akkaya, N., & Topuz, O. (2011). Comparison of ultrasound and ketoprofen phonophoresis in the treatment of carpal tunnel syndrome. *J Back Musculoskelet Rehabil*, *24*(1), 39-47. doi:10.3233/bmr-2011-0273
- Younes, M., Neffati, F., Touzi, M., Hassen-Zrour, S., Fendri, Y., Bejia, I., . . . Najjar, M. F. (2007). Systemic effects of epidural and intra-articular glucocorticoid injections in diabetic and non-diabetic patients. *Joint Bone Spine*, *74*(5), 472-476. doi:10.1016/j.jbspin.2006.10.009
- Young, D., Papp, S., & Giachino, A. (2007). Physical examination of the wrist. *Orthop Clin North Am*, *38*(2), 149-165, v. doi:10.1016/j.ocl.2007.02.011
- Zingas, C., Failla, J. M., & Van Holsbeeck, M. (1998). Injection accuracy and clinical relief of de Quervain's tendinitis. *J Hand Surg Am*, *23*(1), 89-96. doi:10.1016/S0363-5023(98)80095-6
- Zyluk, A., & Szlosser, Z. (2013). The results of carpal tunnel release for carpal tunnel syndrome diagnosed on clinical grounds, with or without electrophysiological investigations: a randomized study. *J Hand Surg Eur Vol*, *38*(1), 44-49. doi:10.1177/1753193412445162