NEW YORK STATE OF OPPORTUNITY. | Workers' Compensation Board

Medical Treatment Guidelines

Elbow Injuries

Effective May 2, 2022

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The NYS Workers' Compensation Board would like to thank the members of the New York Workers' Compensation Board Medical Advisory Committee (MAC). The MAC served as the Board's advisory body to adapt the American College of Occupational and Environmental Medicine (ACOEM) Practice Guidelines to a New York version of the Medical Treatment Guidelines (MTG). In this capacity, the MAC provided valuable input and made recommendations to help guide the final version of these Guidelines. With full consensus reached on many topics, and a careful review of any dissenting opinions on others, the Board established the final product.

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A. GENERAL GUIDELINE PRINCIPLES

The principles summarized in this section are key to the intended application of the New York State Medical Treatment Guidelines (MTG) and are applicable to all Workers' Compensation Medical Treatment Guidelines.

A.1 Medical Care

Medical care and treatment required as a result of a work-related injury should be focused on restoring functional ability required to meet the patient's daily and work activities with a focus on a return to work, while striving to restore the patient's health to its pre-injury status in so far as is feasible.

A.2 Rendering Of Medical Services

Any medical provider rendering services to a workers' compensation patient must utilize the Treatment Guidelines as provided for with respect to all work-related injuries and/or illnesses.

A.3 Positive Patient Response

Positive results are defined primarily as functional gains which can be objectively measured. Objective functional gains include, but are not limited to, positional tolerances, range of motion, strength, endurance, activities of daily living (ADL), cognition, psychological behavior, and efficiency/velocity measures which can be quantified. Subjective reports of pain and function may be considered and given relative weight when the pain has anatomic and physiologic correlation in proportion to the injury.

A.4 Re-Evaluate Treatment

If a given treatment or modality is not producing positive results within a well-defined timeframe, the provider should either modify or discontinue the treatment regime. The provider should evaluate the efficacy of the treatment or modality 2 to 3 weeks after the initial visit and 3 to 4 weeks thereafter. These timeframes may be slightly longer in the context of conditions that are inherently mental health issues, and shorter for other non-musculoskeletal medical conditions (e.g. pulmonary, dermatologic etc.). Recognition that treatment failure is at times attributable to an incorrect diagnosis a failure to respond should prompt the clinician to reconsider the diagnosis in the event of an unexpected poor response to an otherwise rational intervention.

A.5 Education

Education of the patient and family, as well as the employer, insurer, policy makers and the community should be a primary emphasis in the treatment of work-related injury or illness. Practitioners should develop and implement effective educational strategies and skills. An education-based paradigm should always start with communication providing reassuring information to the patient. 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 of future injury.

Time Frames

A.6 Acuity

Acute, Subacute and Chronic are generally defined as timeframes for disease stages:

- Acute – Less than one month
- Subacute - One to three month, and
- Chronic - greater than three months.

A.7 Initial Evaluation

Initial evaluation refers to the acute timeframe following an injury and is not used to define when a given physician first evaluates an injured worker (initial encounter) in an office or clinical setting.

A.8 Diagnostic Time Frames

Diagnostic time frames for conducting diagnostic testing commence on the date of injury. Clinical judgment may substantiate the need to accelerate or decelerate the time frames discussed in this document.

A.9 Treatment Time Frames

Treatment time frames for specific interventions commence once treatments have been initiated, not on the date of injury. It is recognized that treatment duration may be impacted by disease process and severity, 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.

A.10 Delayed Recovery

For those patients who fail to make expected progress 6-12 weeks after an injury and whose subjective symptoms do not correlate with objective signs and tests, reexamination in order to confirm the accuracy of the diagnosis and re-evaluation of the treatment program should be performed. When addressing a clinical issue that is not inherently a mental health issue, assessment for potential barriers to recovery (yellow flags/psychological issues) should be ongoing throughout the care of the patient. At 6-12 weeks, alternate treatment programs, including formal psychological or psychosocial evaluation should be considered. Clinicians must be vigilant for any pre-existing mental health issues or subsequent, consequential mental health issues that may be impacting recovery. For issues that are clearly and inherently mental health issues from the outset (i.e. when it is evident that there is an underlying, work-related, mental health disorder as part of the claim at issue), referral to a mental health provider can and should occur much sooner. Referrals to mental health providers for the evaluation and management of delayed recovery do not indicate or require the establishment of a psychiatric or psychological condition. The evaluation and management of delayed recovery does not require the establishment of a psychiatric or psychological claim.

Treatment Approaches

A.11 Active Interventions

Active interventions emphasizing patient responsibility, such as therapeutic exercise and/or functional treatment, are generally emphasized over passive modalities, especially as treatment progresses. Generally, passive and palliative interventions are viewed as a means to facilitate progress in an active rehabilitation program with concomitant attainment of objective functional gains.

A.12 Active Therapeutic Exercise Program

Active therapeutic exercise program goals should incorporate patient strength, endurance, flexibility, range of motion, sensory integration, coordination, cognition and behavior (when at issue) and education as clinically indicated. This includes functional application in vocational or community settings.

A.13 Diagnostic Imaging And Testing Procedures

Clinical information obtained by history taking and physical examination should be the basis for selection of imaging procedures and interpretation of results. All diagnostic procedures have characteristic specificities and sensitivities for various diagnoses. Usually, selection of one procedure over others depends upon various factors, which may include: relative diagnostic value; risk/benefit profile of the procedure; availability of technology; a patient's tolerance; and/or the treating practitioner's familiarity with the procedure.

When a diagnostic procedure, in conjunction with clinical information, provides sufficient information to establish an accurate diagnosis, a second diagnostic procedure is not required. However, a subsequent diagnostic procedure including a repeat of the original (same) procedure can be performed, when the specialty physician (e.g. physiatrist, sports medicine physician or other appropriate specialist) radiologist or surgeon documents that the initial study was of inadequate quality to make a diagnosis. Therefore, in such circumstances, a repeat or complementary diagnostic procedure is permissible under the MTG.

It is recognized that repeat imaging studies and other tests may be warranted by the clinical course and/or to follow the progress of treatment in some cases. It may be of value to repeat diagnostic procedures (e.g., imaging studies) during the course of care to reassess or stage the pathology when there is progression of symptoms or findings, prior to surgical interventions and/or therapeutic injections when clinically indicated, and post-operatively to follow the healing process. Regarding serial imaging, (including x-rays, but particularly CT scans), it must be recognized that repeat procedures result in an increase in cumulative radiation dose and associated risks.

A given diagnostic imaging procedure may provide the same or distinctive information as obtained by other procedures. Therefore, prudent choice of procedures(s) for a single diagnostic procedure, a complementary procedure in combination with other procedures(s), or a proper sequential order in multiple procedures will ensure maximum diagnostic accuracy, minimize the likelihood of adverse effect on patients, and promote efficiency by avoiding duplication or redundancy.

A.14 Surgical Interventions

Consideration of surgery should be within the context of expected functional outcome. 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 imaging and other diagnostic tests. A comprehensive assimilation of these factors must lead to a specific diagnosis with positive identification of pathologic condition(s). For surgery to be performed to treat pain, there must be clear correlation between the pain symptoms and objective evidence of its cause. In all cases, shared decision making with the patient is advised. The patient should be given the opportunity to understand the pros and cons of surgery, potential for rehabilitation as an alternative where applicable, evidence-based outcomes, and specific surgical experience.

A.15 Pre-Authorization

All diagnostic imaging, testing procedures, non-surgical and surgical therapeutic procedures, and other therapeutics within the criteria of the Medical Treatment Guidelines and based on a correct application of the Medical Treatment Guidelines are considered authorized, with the exception of the procedures listed in section 324.3(1)(a) of Title 12 NYCRR. These are not included on the list of pre-authorized procedures. Providers who want to perform one of these procedures must request pre-authorization from the carrier before performing the procedure.

Second or subsequent procedures (the repeat performance of a surgical procedure due to failure of, or incomplete success from the same surgical procedure performed earlier, if the Medical Treatment Guidelines do not specifically address multiple procedures) also require pre-authorization.

A.16 Psychological/Psychiatric Evaluations

In select patients, mental health evaluations are essential to make, secure or confirm a diagnosis. Of course, the extent and duration of evaluations and/or interventions by mental health professionals may vary, particularly based on whether: the underlying clinical issue in the claim is inherently a mental health issue; or there is a mental health issue that is secondary or consequential to the medical injury or illness that is at issue in the claim in question; or there is a pre-existing, unrelated mental health issue that has been made worse by, or is impeding the recovery from (or both) the medical injury or illness that is at issue in the claim in question.

Tests of psychological function or psychometric testing, when indicated, can be a valuable component of the psychological evaluation in identifying associated psychological, personality and psychosocial issues. Although these instruments may suggest a diagnosis, neither screening nor psychometric tests are capable of making a diagnosis. The diagnosis should only be made after careful analysis of all available data, including from a thorough history and clinical interview.

A professional fluent in the primary language of the patient is strongly preferred. When such a provider is not available, services of a professional language interpreter must be provided.

Frequency: When assessing for a pre-existing, unrelated mental health issue that has been made worse by, or is impeding the recovery from (or both) a work-related, medical injury or illness, then a one-time visit for initial psychiatric/psychological encounter should be sufficient, as care would normally be continued by the prior treating provider. If psychometric testing is indicated by findings in the initial encounter, time for such testing should not exceed an additional three hours of professional time. For conditions in which a mental health issue is a central part of the initial claim, or in which there is a mental health issue that is secondary or consequential to the work-related, medical injury or illness, that is part of the claim in question, then more extensive diagnostic and therapeutic interventions may be clinically indicated, and are discussed in detail in the Medical Treatment Guidelines for such mental health conditions.

A.17 Personality/Psychological/Psychosocial Intervention

Following psychosocial evaluation, when intervention is recommended, such intervention should be implemented as soon as possible. This can be used alone or in conjunction with other treatment modalities. For all psychological/psychiatric interventions, there must be an assessment and treatment plan with measurable behavioral goals, time frames and specific interventions planned**.**

- Time to produce effect: two to eight weeks.
- Optimum duration: six weeks to three months.
- Maximum duration: three to six months.
- Counseling is not intended to delay but rather to enhance functional recovery.

For PTSD Psychological Intervention:

- Optimum duration three to six months.
- Maximum duration: nine to twelve months.

For select patients, longer supervision and treatment may be required, and if further treatment is indicated, documentation of the nature of the psychological factors, as well as projecting a realistic functional prognosis, should be provided by the authorized treating practitioner every four weeks during the first six months of treatment. For treatment expected to last six to twelve months, such documentation should be provided every four to eight weeks. For long-term treatment beyond twelve months, such documentation should be provided every eight to twelve weeks. All parties should strive for ongoing and continuous communications, in order to facilitate seamless, continuous and uninterrupted treatment.

A.18 Functional Capacity Evaluation (FCE)

Functional capacity evaluation is a comprehensive or more restricted evaluation of the various aspects of function as they relate to the patient's ability to return to work. Areas such as endurance, lifting (dynamic and static), postural tolerance, specific range-of-motion, coordination and strength, worker habits, employability, as well as psychosocial, cognitive, and sensory perceptual aspects of competitive employment may be evaluated. 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; (h) non-material and material handling activities; (i) cognitive and behavioral; (j) visual; and (k) sensory perceptual factors.

In most cases, the question of whether a patient can return to work can be answered without an FCE.

An FCE may be considered at time of MMI, following reasonable prior attempts to return to full duty throughout course of treatment, when the treating physician is unable to make a clear determination on work status on case closure. An FCE is not indicated early during a treatment regime for any reason including one to support a therapeutic plan.

When an FCE is being used to determine return to a specific job site, the treating physician is responsible for understanding and considering the job duties. FCEs cannot be used in isolation to determine work restrictions. The authorized treating physician must interpret the FCE in light of the individual patient's presentation and medical and personal perceptions. FCEs should not be used as the sole criteria to diagnose malingering.

A.19 Return To Work

For purposes of these guidelines, return to work is defined as any work or duty that the patient is able to perform safely. It may not be the patient’s regular work. Ascertaining a return to work status is part of medical care, and should be included in the treatment and rehabilitation plan. It is normally addressed at every outpatient visit. A description of the patient’s status and task limitations is part of any treatment plan and should provide the basis for restriction of work activities when warranted. Early return to work should be a prime goal in treating occupational injuries. The emphasis within these guidelines is to move patients along a continuum of care and return to work, since the prognosis of returning an injured worker to work drops progressively the longer the worker has been out of work.

A.20 Job Site Evaluation

The treating physician may communicate with the employer or employer’s designee, either in person, by video conference, or by telephone, to obtain information regarding the individual or specific demands of the patient’s pre-injury job. This may include a description of the exertional demands of the job, the need for repetitive activities, load lifting, static or awkward postures, environmental exposures, psychological stressors and other factors that would pose a barrier to re-entry, risk of re-injury or disrupt convalescence. When returning to work at the patient’s previous job tasks or setting is not feasible, given the clinically determined restrictions on the patient’s activities, inquiry should be made about modified duty work settings that align with, the patient’s condition in view of proposed work activities/demands in modified duty jobs. It should be noted, that under certain circumstances, more than one job site evaluation may be indicated.

Ideally, the physician would gain the most information from an on-site inspection of the job settings and activities; but it is recognized that this may not be feasible in most cases. If job videos/CDs/DVDs are available from the employer, these can contribute valuable information, as can video conferences, conducted from the worksite and ideally workstation or work area.

Frequency: one or two contacts

- 1st contact: Patient is in a functional state where the patient can perform some work.
- 2nd contact: Patient has advanced to state where the patient is capable of enhanced functional demands in a work environment.

The physician shall document the conversation.

Other

A.21 Guideline Recommendations And Medical Evidence

The Workers' Compensation Board and its Medical Advisory Committee have not independently evaluated or vetted the scientific medical literature used in support of the guidelines, but have relied on the methodology used by the developers of various guidelines utilized and referenced in these Guidelines.

A.22 Experimental/Investigational Treatment

Medical treatment that is experimental/investigational and not approved for any purpose, application or indication by the FDA is not permitted under these Guidelines.

A.23 Injured Workers As Patients

In these Guidelines, injured workers are referred to as patients recognizing that in certain circumstances there is no doctor-patient relationship.

A.24 Scope Of Practice

These Guidelines do not address scope of practice or change the scope of practice.

Elbow Injuries

Effective date will coincide with the launch of OnBoard: Limited Release

B. Introduction to Elbow Injury

B.1 History Taking and Physical Examination

History taking and physical examination establish the foundation/basis for and dictate subsequent stages of diagnostic and therapeutic procedures. When findings of clinical evaluations and those of other diagnostic procedures are not consistent with each other, the objective clinical findings should have preference. The medical records should reasonably document the following:

B.1.a History of Present Injury

- Mechanism of injury: This includes details of symptom onset and progression, and symptoms that may arise from postural or functional accommodation to the elbow injury;
- Relationship to work: This includes a statement of the probability that the illness or injury is work-related;
- Prior occupational and non-occupational injuries: To the same area including specific prior treatment;
- Ability to perform job duties and activities of daily living; and
- Exacerbating and alleviating factors for symptoms; not limited to the elbow.

B.1.b Past History

- Past medical history includes, but is not limited to, neoplasm, gout, arthritis, and diabetes;
- Review of systems includes, but is not limited to, symptoms of rheumatologic, neurologic, endocrine, neoplastic, and other systemic diseases;
- Smoking history;
- Vocational and recreational pursuits;
- Prior imaging studies; and
- Past surgical history.

B.1.c Physical Examination

Examination of a joint should include the joint above and below the affected area, including the opposite side for comparison. Physical examination should include accepted tests and exam techniques applicable to the joint or area being examined, including:

- Visual inspection;
- Palpation;
- Range of motion/quality of motion (active and passive);
- Strength (weakness/atrophy);
- Joint integrity/stability;
- Examination for deformity (including claw phenomenon)/displacement;
- If applicable to injury, integrity of distal circulation; and/or
- If applicable, neurological exam (i.e: sensory and motor function, reflexes) as clinically indicated.

B.2 Red Flags

Certain findings, "red flags", raise suspicion of potentially serious medical conditions. Assessment (history and physical examination) should include evaluation for red flags. In the elbow these findings or indicators may include: fracture, dislocations, infection or inflammation; and neurological or vascular compromise including compartment syndrome. Further evaluation/consultation or urgent/emergency intervention may be indicated, and the New York Elbow Injury Medical Treatment Guidelines incorporate changes in clinical management triggered by the presence of "red flags."

Table 1 - Red Flags for Potentially Serious Elbow Disorders

Disorder	Medical History	Physical Examination
Fracture	History of significant trauma Fall on outstretched hand Fall onto lateral elbow	Deformity consistent with fracture Reduced range(s) of motion Pain with range of motion Disturbance in the triangular relationship between the olecranon and the epicondyles Significant bruising, if subacute (unusual)
Dislocation	History of fall/trauma as above History of deformity with or without spontaneous reduction	Deformity consistent with dislocation Hemarthrosis
Infection	Pain, swelling, redness Diabetes mellitus History of immunosuppression (e.g., transplant, chemotherapy, HIV) History of systemic symptoms	Localized heat, swelling, erythema Purulence Erythematous streaks, especially from a portal of entry Systemic signs of infection
Tumor	History of cancer Unintentional weight loss Continuous pain, especially at night	Palpable mass not consistent with usual diagnoses

	and not improved with rest	
Inflammation	History of gout or pseudogout History of rheumatoid arthritis History of other inflammatory arthritides	Effusion Localized heat, swelling, erythema, tenderness
Rapidly Progressive Neurologic Deficit	History of neurologic disease Trauma	Abnormal neurologic examination Focal or global motor weakness distal to the elbow Weakness may be limited to one nerve, such as hand intrinsic muscles
Vascular Compromise	History of diabetes mellitus Tobacco use History of fracture or dislocation History of vascular disease of any kind	Decreased or absent peripheral pulses and delayed capillary refill Edema
Compartment Syndrome	History of trauma, surgery or extreme unaccustomed forceful activity Persistent forearm pain and "tightness" Tingling, burning, or numbness	Palpable tenderness and tension of involved compartment Pain intensified with stretch to involved muscles Paresthesia, paresis, and sensory deficits Diminished pulse and prolonged capillary refill

C. Diagnostic Testing and Testing Procedures

C.1 Introduction

One diagnostic imaging procedure may provide the same or distinctive information as obtained by other procedures. Therefore, prudent choice of procedure(s) for a single diagnostic procedure, a complementary procedure in combination with other procedures(s), or a proper sequential order in multiple procedures will ensure maximum diagnostic accuracy, minimize adverse effect to patients and promote cost effectiveness by avoiding duplication or redundancy.

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.

When a diagnostic procedure, in conjunction with clinical information, provides sufficient information to establish an accurate diagnosis, the second diagnostic procedure will be redundant if it is performed only for diagnostic purposes. At the same time, a subsequent diagnostic procedure (that may be a repeat of the same procedure, when the rehabilitation physician, radiologist or surgeon documents that the study was of inadequate quality to make a diagnosis) 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.

It is recognized that repeat imaging studies and other tests may be warranted by the clinical course and to follow the progress of treatment in some cases. It may be of value to repeat diagnostic procedures (e.g. imaging studies) during the course of care to reassess or stage the pathology when there is progression of symptoms or findings, prior to surgical interventions and therapeutic injections when warranted, and post-operatively to follow the healing process. Regarding CT examinations, it must be recognized that repeat procedures result in an increase in cumulative radiation dose and associated risks.

When indicated, the following studies can be utilized for further evaluation of elbow injuries, based upon the mechanism of injury, symptoms, and patient history.

C.2 Diagnostic Criteria and Differential Diagnosis

The criteria presented in Table 2 follow the clinical thought process, from the mechanism of illness or injury, to unique symptoms and signs of a particular disorder. Elbow disorders, as described by the patient, can sometimes be consistent with radiating symptoms from the neck or shoulder, and the examining physician's diagnostic acumen is important in determining the source. For example, mid-upper-arm pain on arm elevation is most likely related to a problem originating in the shoulder area, not the elbow, although patients may have pain in both areas. It is important to note that lateral elbow pain can be due to cervical disc disease (C6), radial nerve entrapment (including radial tunnel syndrome), synovitis due to degeneration, or true epicondylitis (enthesitis). A complaint of tingling and/or numbness in the fourth and fifth fingers is usually due to ulnar nerve impingement at the elbow, C8 cervical radiculopathy, or impingement of the ulnar nerve at the wrist. Thoracic outlet syndrome can be considered, although that condition is generally believed to be quite uncommon (see Shoulder Disorders chapter). For the differential diagnosis of lateral epicondylalgia, C6 radiculopathy is believed to be the most common alternate diagnosis and not infrequently presents with lateral elbow pain and paresthesias in the thumb. The differential diagnosis of medial epicondylalgia similarly includes C8 radiculopathy presenting as medial elbow pain and paresthesias in the fourth and fifth digits.

Medial collateral ligament problems may also present with medial elbow pain. Concomitant existence of medial epicondylalgia with ulnar neuropathy at the elbow frequently occurs. In cases of complaints that cannot be classified as a specific pathophysiological condition, a diagnosis of non-specific pain should be used. This is far preferable to specific labeling, which may not be accurate. Non-specific or regional pain will more frequently be the most appropriate diagnosis if there are no specific physical findings. The criteria presented in Table 2 below list the probable diagnosis or injury, potential mechanism(s) of illness or injury, symptoms, signs, and appropriate tests and results to consider in assessment and treatment.

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

Table 2 - Criteria for Non-Red Flag Conditions

Probable Diagnosis or Injury	Mechanism	Symptoms	Signs
Contusion	Direct blow Fall	Local pain	Range of motion usually normal Soft tissue swelling Ecchymosis
Lateral Epicondylalgia/ Epicondylitis/ Tendinosis	Possibly related to forceful use of elbow or wrist, repetition and postural factors Some cases related to acute trauma	Pain in lateral elbow. [Absence of tingling/numbness.] [Absence of neck pain or stiffness.]	Tenderness over epicondyle and 2-3 centimeters distal to it over the extensor carpi radialis brevis and extensor digitorum tendons Pain in lateral elbow with resisted extension of wrist or middle finger Pain in the lateral elbow with forceful grasp Normal elbow range of motion Diffuse lateral elbow pain with repeated wrist dorsiflexion
Medial Epicondylalgia/ Epicondylitis/ Tendinosis	Etiology is unknown Theorized to parallel that of lateral epicondylalgia	Pain in medial elbow [Absence of tingling/numbness in most cases unless accompanied by ulnar neuropathy] [Absence of neck pain or stiffness]	Tenderness over medial epicondyle or 2 to 3 centimeters distal to it Pain in medial elbow with resisted wrist or phalangeal flexion Normal elbow range of motion
Olecranon Bursitis (noninfectious)	Prolonged leaning on	Swelling of bursa	Effusion/mass effect in bursa

	elbow/chronic pressure Acute trauma Chronic pressure	Pain in bursa generally absent or minor	Tenderness over bursa generally not present or minor Tenderness more likely with complications of inflammatory arthropathy
Olecranon Bursitis (infectious)	Trauma with non-intact dermis Introduced infections from injection(s) Systemic infection	Progressive painful swelling of bursa Systemic signs of infection	Erythema, warmth and/or surrounding cellulitis Marked tenderness over bursa
Nondisplaced Radial Head Fracture	Fall onto outstretched hand Fall onto lateral elbow	Lateral elbow pain Pain on pronation and supination of forearm	Maximal tenderness over radial head Reduced elbow extension when compared with unaffected side
Biceps Tendinosis	Forceful flexion, particularly near maximal or repeated high force Unaccustomed forceful use	Pain in anterior elbow joint or antecubital fossa	Tenderness on palpation of biceps myotendinous junction
Radial Nerve Entrapment (including Radial Tunnel Syndrome)	Etiology is unknown; there are no quality epidemiological studies.	Studies of the clinical presentation of this disorder are not well performed. Thought to involve aching pain in extensor/supinator area of forearm.	Physical exam findings are not well characterized for this disorder. Pain on stressing extended middle finger Maximum tenderness 4 finger breadths anterior and inferior to lateral epicondyle

			Utility of Hoffman-Tinel's test undetermined
Pronator Syndrome	Etiology unclear	Pain in proximal forearm with paraesthesias in median nerve distribution of hand	May be tender over pronator muscle
Ulnar Nerve Entrapment (including Cubital Tunnel Syndrome)	Two main categories involving cubital tunnel and condylar groove Etiologies are unclear; there are no quality epidemiological studies Theorized mechanisms include hyperflexion of the elbow or prolonged leaning on the elbows for condylar groove segment neuropathies	Paresthesias in the ring and 5th digits; generally spares dorsal surfaces Pain may or may not be present	Paresthesias in ring and small fingers on 60-second elbow flexion test Subluxation of the ulnar nerve in the condylar groove sometimes present Weakness/atrophy of ulnar hand intrinsics and interosseous muscles (unusual/late) Hoffman-Tinel's test over the condylar groove segment is thought to not be helpful as it is often abnormal in the absence of symptoms.

C.2.a Elbow Arthroscopy

Arthroscopy of the elbow has been used for diagnosis and treatment of some patients with elbow disorders, however, indications for either diagnostic or therapeutic procedures are not well defined with quality studies.

C.2.a.i Elbow Arthroscopy for Diagnosing Elbow Pain with Suspicion of Intraarticular Body and Other Subacute or Chronic Mechanical Symptoms

Recommended - to evaluate and diagnose patients with elbow pain that have suspicion of intraarticular body, and other subacute or chronic mechanical symptoms.

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

C.2.a.ii Arthroscopy for Diagnosing Acute Elbow Pain

Not Recommended - for diagnosing acute elbow pain.

C.2.a.iii Elbow Arthroscopy

Recommended – for diagnosis or treatment of patients with osteoarthrosis in the presence of a remediable mechanical defect such as symptomatic loose body.

Not Recommended - for diagnosis or treatment of patients with osteoarthrosis in the absence of a remediable mechanical defect such as symptomatic loose body.

C.2.a.iv Elbow Arthroscopy with Chondroplasty for Osteoarthrosis

Not Recommended - for treatment of osteoarthrosis.

C.2.b Bone Scans

Bone scans involve intravenous administration of a radioactive tracer medication that is preferentially concentrated in areas of metabolic activity in bone. The radioactivity is then detected by a large sensor and converted into images of the skeleton. There are many causes for abnormal radioactive uptake, including metastases, infection, inflammatory arthropathies, fracture or other significant bone trauma. Thus, positive bone scans are not highly specific. Bone scans have been used for diagnosis of early osteonecrosis prior to findings on x-ray, among other uses.

C.2.b.i Bone Scanning for Select Use in Acute, Subacute or Chronic Elbow Pain

Recommended - for select use in acute, subacute or chronic elbow pain to assist in the diagnosis of osteonecrosis, neoplasms and other conditions with increased polyosthotic bone metabolism, particularly where there is more than one joint to be evaluated.

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

C.2.b.ii Routine Use of Bone Scanning for Routine Elbow Joint Evaluations

Not Recommended - for routine use in elbow joint evaluations.

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

C.2.c Computerized Tomography

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

C.2.c.i Routine CT for Evaluating Acute, Subacute, Chronic Elbow Pain

Not Recommended - for evaluation of acute, subacute, or chronic elbow pain.

C.2.c.ii CT for Evaluating Patients with Osteonecrosis (AVN)

Recommended - for evaluating patients with osteonecrosis or following traumatic dislocations or arthroplasty-associated recurrent dislocations, or for patients who need advanced imaging but have contraindications for MRI.

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

C.2.c.iii Helical CT for Select Acute, Subacute, or Chronic Elbow Pain

Recommended - for select patients with acute, subacute, or chronic elbow pain in whom advanced imaging of bony structures is thought to be potentially helpful, and for patients with a need for advanced imaging but who have contraindications for MRI.

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

Rationale for Recommendations - Computerized tomography is considered superior to MRI for imaging of most elbow abnormalities where advanced imaging of calcified structures is required. Helical CT scan has been thought to be superior to MRI for evaluating subchondral fractures; however, a definitive study has not been reported

C.2.d Electromyography and Nerve Conduction Studies (Electrodiagnostic Studies)

Electrodiagnostic (ED) studies have been used to confirm diagnostic impressions of other peripheral nerve entrapments, including all peripheral nerves in the upper extremity. They may be particularly helpful to distinguish a peripheral entrapment from cervical radiculopathy. EMG and NCS may be normal, particularly in some mild cases of neuropathies. If ED studies are negative, tests may be repeated later in the course of treatment if symptoms persist. It is also important to recognize that ED studies are abnormal in a considerable proportion of patients who are without symptoms. Thus, ED studies in a patient with a low pre-test probability of peripheral nerve entrapment may result in inappropriate diagnosis.

C.2.d.i Electrodiagnostic Studies for Diagnosing Subacute or Chronic Peripheral Nerve Entrapments

Recommended - to assist in the diagnosis of subacute or chronic peripheral nerve entrapments, including ulnar neuropathies, radial neuropathies and median neuropathies.

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

C.2.d.ii Electrodiagnostic Studies for Diagnosis and Pre-Operative Assessment of Peripheral Nerve Entrapments

Recommended - to assist in securing a firm diagnosis for those patients without a clear diagnosis. ED studies are also recommended as one of two methods to attempt to objectively secure a diagnosis prior to surgical release.

C.2.d.iii Electrodiagnostic Studies for Initial Evaluation of Patients Suspected of Having a Peripheral Nerve Entrapment

Not Recommended - for initial evaluation of most patients as it does not change the management of the condition.

Rationale for Recommendation - ED studies are primarily of assistance in: 1) identifying an anatomic location of nerve conduction slowing; 2) identifying objective evidence for alternate diagnostic considerations (e.g., cervical radiculopathy); and 3) quantifying nerve function to assure the physician that an operative state such as CTS is present. They are recommended for evaluation of select cases to assist in confirming peripheral nerve entrapments such as pronator syndrome, ulnar neuropathies at the elbow and radial neuropathies.

C.2.e Magnetic Resonance Imaging (MRI)

Magnetic resonance imaging (MRI) is considered the imaging test of choice for viewing soft tissues (including ligamentous injuries around the elbow). MRI is helpful for evaluating extent of biceps tendinosis and ruptures. MRI is considered the gold standard for evaluating osteonecrosis after x-rays. However, for most elbow disorders, MRI is not useful as an imaging procedure.

C.2.e.i MRI for Diagnosing Osteonecrosis (AVN)

Recommended - for diagnosing osteonecrosis and ligamentous elbow injuries.

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

C.2.e.ii MRI for Routine Evaluation of Acute, Subacute, Chronic Elbow Joint Pathology

Not Recommended - for routine evaluation of acute, subacute, or chronic elbow joint pathology, including degenerative joint disease.

Rationale for Recommendations - MRI is not recommended for routine elbow imaging, but is recommended for select elbow joint pathology particularly involving concerns regarding soft tissue pathology.

C.2.f Roentgenograms (X-RAYS)

X-rays show bony structure and remain the initial test for evaluation of most cases of elbow pain. Two or three views are generally performed.

C.2.f.i X-rays for Evaluation of Acute, Subacute, or Chronic Elbow Pain

Recommended - for evaluation of acute, subacute, or chronic elbow pain.

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

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

Rationale for Recommendations - X-rays are helpful to evaluate most patients with elbow pain, both to diagnose and to assist with the differential diagnostic possibilities.

C.2.g Single Proton Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET)

Single proton emission computed tomography (SPECT) is a 3-dimensional imaging technique in which radionucleotide tracers that release gamma radiation are used to create multiplanar re-formations.

C.2.g.i SPECT or PET for Diagnosing Acute, Subacute, or Chronic Elbow Pain

Not Recommended - for diagnosing acute, subacute, or chronic elbow pain.

Rationale for Recommendation - There is no quality evidence to support the use of these scans to evaluate patients with elbow pain.

C.2.h Ultrasound

C.2.h.i Diagnostic Ultrasound for Other Elbow Disorders, Including Osteonecrosis, Osteoarthrosis, Dysplasia and Fractures

Not Recommended - for the evaluation and diagnosis of other elbow disorders, including osteonecrosis, osteoarthrosis, dysplasia, and fractures.

C.2.i Laboratory Testing

Laboratory tests are rarely indicated at the time of initial evaluation, unless there is suspicion of systemic illness, infection, neoplasia, connective tissue disorder, or underlying arthritis or rheumatologic disorder based on history and/or physical examination. Tests include, but are not limited to:

C.2.i.i Antibodies

There are numerous antibodies that are markers for specific rheumatic diseases (e.g., rheumatoid factor, anti-nuclear antibodies, anti-Sm, anti-Ro, anti-La for rheumatoid arthritis, systemic lupus erythematosus, Sjogren's, mixed connective tissue disorder, etc.). Patients with rheumatic disorders are at increased risk for degenerative joint disease of the elbow.

C.2.i.ii Antibodies for Diagnosing Elbow Pain with Suspicion of Chronic or Recurrent Rheumatological Disorder

Recommended - to evaluate and diagnose patients with elbow pain who have reasonable suspicion of rheumatological disorder.

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

C.2.i.iii Antibodies to Confirm Specific Disorders

Recommended - as a screen to confirm specific disorders (e.g., rheumatoid arthritis).

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

Rationale for Recommendations - Elevated antibody levels are highly useful for confirmation of clinical impressions of rheumatic diseases. However, routine use of these tests in patients with elbow pain – especially as wide-ranging, non-focused test batteries – are likely to result in inaccurate diagnoses due to false positives and low pre-test probabilities and are not recommended. Providers should also be aware that false negative results occur. They are recommended for focused testing of a limited number of diagnostic considerations.

C.2.i.iv C-Reactive Protein, Erythrocyte Sedimentaiton Rate, and Other Non Specific Inflammatory Markers

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

Non-Specific Inflammatory Markers for Screening for Inflammatory Disorders in Patients with Subacute or Chronic Elbow Pain

Recommended - for screening for inflammatory disorders or prosthetic sepsis with reasonable suspicion of inflammatory disorder in patients with subacute or chronic elbow pain.

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

Rationale for Recommendation -Erythrocyte sedimentation rate is the most commonly used systemic marker for non-specific inflammation and is elevated in numerous inflammatory conditions including rheumatological disorders, as well as with infectious diseases. C-reactive protein is a marker of systemic inflammation that has been associated with an increased risk of coronary artery disease. However, it is also a non-specific marker for other inflammation. Other non-specific markers of inflammation include ferritin, and an elevated protein-albumin gap, which have no known clinical roles. They are recommended as a reasonable screen for systemic inflammatory conditions especially if the elbow pain patient also has other pains without clear definition of a diagnosis or those with fibromyalgia or myofascial pain syndrome, although the specificity is not high. However, ordering of a large, diverse array of anti-inflammatory markers without targeting a few specific disorders diagnostically is not recommended.

D. Conditions

This guideline addresses the following elbow related work conditions.

D.1 Contusions

D.2 Lateral Epicondylalgia

D.3 Olecranon Bursitis

D.4 Elbow Fractures, Including Non-Displaced Radial Head Fractures

D.5 Elbow Dislocations

D.6 Elbow Lacerations

D.7 Elbow Sprains

D.8 Biceps Tendinosis (or Tendinitis) and Tears/Ruptures

D.9 Triceps Tendinosis (or Tendinitis) and Tears/Ruptures

D.10 Ulnar Neuropathies at the Elbow; Including Condylar Grove Associated Ulnar Neuropathy and Cubital Tunnel Syndrome

D.11 Radial Nerve Entrapment (Including Radial Tunnel Syndrome)

D.12 Pronator Syndrome (Median Neuropathies in the Forearm)

D.1 Contusions

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

D.1.a Medications

D.1.a.i NSAIDs, Acetaminophen

Recommended - for elbow contusions.

D.1.b Treatments

D.1.b.i Immobilization for Elbow Contusions

Not Recommended - for elbow contusions.

Rationale for Recommendation - Medical management of contusions is recommended to be directed at maintaining normal elbow function. Accordingly, treatment should include anti-inflammatory medications with avoidance of immobilization. Early mobilization should also be encouraged. Medical management can be summarized as rest, ice, compression, elevation, and range-of-motion exercises.

D.1.b.ii Ice, Compression, and Range-of-Motion Exercises for Contusions

Recommended - for elbow contusions

D.2 Epicondylitis (Epicondylalgia)

D.2.a Lateral Epicondylitis; Tennis Elbow

D.2.a.i Laterial Epicondylitis Diagnostic Criteria

Lateral epicondylitis (Tennis Elbow) causes soreness or pain on the outside (lateral) side of the upper arm near the elbow. Lateral epicondylitis is diagnosed based on a combination of lateral elbow pain plus tenderness to palpation over the lateral epicondyle or tenderness within a couple centimeters distal to the epicondyle. Most patients require no special testing provided red flags are absent. For patients who have been treated for at least four weeks and symptoms have failed to improve, additional testing may be required.

Patients should not have other potential explanatory conditions such as cervical radiculopathy (especially C-6), elbow arthrosis or fibromyalgia. Some patients will have onset after a traumatic event, usually a relatively mild accident such as bumping the elbow on a hard surface; however, this is not required to make a diagnosis.

D.2.b Medial Epicondylitis; Golfer's Elbow

D.2.b.i Medial Epicondylitis Diagnostic Criteria

Medial epicondylitis is substantially less common affecting the medial or inner aspect of the elbow. Medial epicondylalgia is sometimes thought to occur concomitantly with ulnar neuropathy at the elbow. Treatment of medial epicondylitis is analogous to lateral epicondylitis.

Evidence for Medial Epicondylalgia

D.2.c Special Studies and Diagnostic and Treatment Considerations

Most patients require no special testing provided red flags are absent. For patients who have been treated for at least four weeks and symptoms have failed to improve, additional testing may be required. Some patients require testing to eliminate alternate diagnostic possibilities such as C-6 cervical radiculopathy (typically with MRI), or arthrosis (x-ray of the elbow). EMG may be used for cervical radiculopathy but is recommended at least 6 weeks after symptom onset to allow sufficient time for EMG changes to be manifest (require three weeks minimum).

D.2.d Medications

For most patients, ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Acetaminophen (or the analog paracetamol) may be a reasonable alternative to NSAIDs for patients who are not candidates for NSAIDs, although most evidence suggests acetaminophen is modestly less effective. There is evidence that NSAIDs are as effective for relief of pain as opioids (including tramadol) and less impairing.

D.2.d.i Non-Steroidal Anti-inflammatory Drugs (NSAIDs)

NSAIDs for Treatment of Acute, Subacute, Chronic, or Post-operative Epicondylalgia

<u>**Recommended**</u> - for treatment of acute, subacute, chronic, or post-operative epicondylalgia.

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

Frequency/Duration – As needed use may be reasonable for many patients.

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

D.2.d.ii NSAIDs for Patients at High Risk of Gastrointestinal Bleeding.

Recommended – concomminent use of cytoprotective classes of drugs: misoprostol, sucralfate, histamine Type 2 receptor blockers, and proton pump inhibitors for patients at high risk of gastrointestinal bleeding.

Indications – For patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications should be considered, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, elderly, diabetics, and cigarette smokers.

Frequency/Dose/Duration – Proton pump inhibitors, misoprostol, sucralfate, H2 blockers recommended. Dose and frequency per manufacturer. There is not generally believed to be substantial differences in efficacy for prevention of gastrointestinal bleeding.

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

D.2.d.iii NSAIDs for Patients at Risk for Cardiovascular Adverse Effects

Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed.

Recommended - Acetaminophen or aspirin as the first-line therapy appear to be the safest regarding cardiovascular adverse.

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

D.2.d.iv Acetaminophen for Treatment of Elbow Pain

Recommended - for treatment of elbow pain, particularly in patients with contraindications for NSAIDs.

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

Dose/Frequency – Per manufacturer's recommendations; may be utilized on an as-needed basis. There is evidence of hepatic toxicity when exceeding four gm/day.

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

Evidence for the Use of NSAIDs for Lateral Epicondylalgia

D.2.d.v Topical NSAIDs

Topical NSAIDs for Treatment of Acute, Subacute, Chronic, or Post-Operative Epicondylalgia

Recommended - for acute, subacute, chronic, or post-operative lateral epicondylalgia.

Indications – For most patients, oral medications are recommended. However, for those with contraindications for oral NSAIDs or intolerance, topical NSAIDs may be a reasonable alternative.

Frequency/Dose/Duration – Per manufacturer's recommendations.

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

Evidence for the Use of Topical NSAIDs and Other Agents for Lateral Epicondylalgia

D.2.d.vi Opioids

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

D.2.d.vi.a Opioids for Select Patients with Post-Operative Epicondylalgia

Recommended - for select treatment of patients with post-operative epicondylalgia.

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

Frequency/Dose/Duration – Generally, patients require no more than a few days to not more than one week, of treatment with opioids for most epicondylar surgeries.

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

D.2.d.vi.b Opioids for Acute, Subacute, or Chronic Epicondylalgia

Not Recommended - for acute, subacute, or chronic epicondylalgia.

Rationale for Recommendations - There are no quality studies evaluating opioids for treating epicondylalgia. Opioids cause significant adverse effects – poor tolerance, constipation, drowsiness, clouded judgment, memory loss, and potential misuse or dependence have been reported in up to 35% of patients. Before prescribing opioids, patients should be informed of these potential adverse effects and cautioned against operating motor vehicles or machinery. Opioids do not appear to be more effective than safer analgesics for managing most musculoskeletal symptoms; they should only be used if needed for severe pain or for a short time (not more than one week) in the post-operative time. Opioids are not recommended for treatment of epicondylalgia patients, except as a brief post-operative course.

Evidence for Use of Opioids for Lateral Epicondylalgia

D.2.e Rehabilitation: Devices / Therapy

Rehabilitation required as a result of a work-related injury should be focused on restoring functional ability required to meet the patient's daily and work activities and return to work; striving to restore the injured worker to pre-injury status in so far as is feasible.

Active therapy requires an internal effort by the individual to complete a specific exercise or task. This form of therapy requires supervision from a therapist such as verbal, visual and/or tactile instruction(s). At times, the therapist may help stabilize the patient or guide the movement pattern, but the energy required to complete the task is predominately executed by the patient. Patient should be instructed to continue active therapies at home as an extension of the treatment process in order to maintain improvement levels.

Active interventions should be emphasized over passive interventions. Passive interventions, those not requiring the exertion of effort on the part of the patient, but rather dependent on modalities delivered by a therapist. Generally passive interventions are viewed as a means to facilitate progress in an active therapy program with concomitant attainment of objective functional gains.

Assistive devices may be included as an adjunctive measure incorporated into the rehabilitation plan to facilitate functional gains.

Devices

D.2.e.i Tennis Elbow Bands, Straps, and Braces for Acute, Subacute, and Chronic Epicondylalgia

Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

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

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

D.2.e.ii Cock-up Wrist Braces for Acute, Subacute, or Chronic Epicondylalgia

Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

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

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

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

Evidence for the Use of Epicondylalgia Supports

Therapy (Active and Passive)

Rehabilitation (supervised formal therapy) required as a result of a work-related injury should be focused on restoring functional ability required to meet the patient's daily and work activities and return to work; striving to restore the injured worker to pre-injury status in so far as is feasible.

Active therapy requires an internal effort by the patient to complete a specific exercise or task. Passive therapy are those interventions not requiring the exertion of effort on the part of the patient, but rather are dependent on modalities delivered by a therapist. Generally passive interventions are viewed as a means to facilitate progress in an active therapy program with concomitant attainment of objective functional gains. Active interventions should be emphasized over passive interventions.

The patient should be instructed to continue both active and passive therapies at home as an extension of the treatment process in order to maintain improvement levels.

Assistive devices may be included as an adjunctive measure incorporated into the rehabilitation plan to facilitate functional gains.

Active Therapy

D.2.e.iii Therapeutic Exercise - Physical / Occupational Therapy

Physical or Occupational Therapy for Acute, Subacute, Chronic, or Post-operative Epicondylalgia

Recommended - for the treatment of acute, subacute, chronic, or post-operative epicondylalgia.

Frequency/Dose/Duration –Total numbers of visits may be as few as two to three for patients with mild functional deficits or up to 12 to 15 with more severe deficits with documentation of ongoing objective functional improvement.

When there are ongoing functional deficits, more than 12 to 15 visits may be indicated if there is documentation of functional improvement towards specific objective functional goals (e.g., increased grip strength, key pinch strength, range of motion, advancing ability to perform work activities). As part of the rehabilitation plan a home exercise program should be developed and performed in conjunction with the therapy.

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

Evidence for Exercise Programs for Lateral Epicondylalgia

Passive Therapy

D.2.e.iv Heat or Cold Packs

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

Recommended - for the treatment of acute, subacute, chronic, or post-operative epicondylalgia.

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

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

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

D.2.e.v Iontophoresis

Iontophoresis with administration of either glucocorticosteroids or NSAIDs for Acute, Subacute, or Chronic Epicondylalgia

Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

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

Frequency/Dose/Duration – Various medications have been used in the quality studies. These include dexamethasone, naproxen, and ketorolac.

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

Evidence for the Use of Iontophoresis for Lateral Epicondylalgia

D.2.e.vi Ultrasound

Ultrasound for Acute, Subacute, or Chronic Epicondylalgia

Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

Indications – For acute, subacute, or chronic epicondylalgia patients; patients who cannot tolerate oral NSAIDs and exercise; or patients who fail other treatments (e.g., insufficient pain relief with elbow straps and activity modification) may be ideal candidates. Generally, moderately to severely affected patients are thought to be better candidates. Overall effect of ultrasound appears modest, thus other interventions are recommended first, particularly exercise.

Frequency/Dose/Duration – Various regimens have been utilized in the quality studies. The two trials showing the most benefit utilized 10 to 12 treatments over four to six weeks.

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

Evidence for the Use of Ultrasound for Lateral Epicondylalgia

Other Therapies

D.2.e.vii Manipulation and Mobilization

D.2.e.vii.a Soft Tissue Mobilization for Acute, Subacute, or Chronic Epicondylalgia

Not Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

D.2.e.vii.b Manipulation and Mobilization for Acute, Subacute, or Chronic Epicondylalgia

Not Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

Evidence for the Use of Manipulation and Mobilization for Lateral Epicondylalgia

D.2.e.viii Massage, Including Friction Massage, for Acute, Subacute, or Chronic Epicondylalgia

Not Recommended: Massage, including friction massage,

Evidence for the Use of Massage and Friction Massage for Epicondylalgia

D.2.e.ix Magnets and Pulsed Electromagnetic Field for Acute, Subacute, or Chronic Epicondylalgia

Not Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

Evidence for the Use of Magnets for Lateral Epicondylalgia

D.2.e.x Extracorporeal Shockwave Therapy for Acute, Subacute, or Chronic Epicondylalgia

Not Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

Evidence for the Use of Extracorporeal Shockwave Therapy for Lateral Epicondylalgia

D.2.e.xi Phonophoresis for Acute, Subacute, or Chronic Epicondylalgia

Not Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

Evidence for the Use of Phonophoresis for Lateral Epicondylalgia

D.2.e.xii Low-Level Laser Therapy for Acute, Subacute, or Chronic Epicondylalgia

Not Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

Evidence for the Use of Low-Level Laser Therapy for Lateral Epicondylalgia

D.2.e.xiii Acupuncture

D.2.e.xiii.a Acupuncture for Select Chronic Epicondylalgia

Recommended - for the treatment of select patients with chronic epicondylalgia.

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

Frequency/Dose/Duration – Regimens were two to three treatments a week for eight to ten treatments. Patients should demonstrate benefit after four to five visits otherwise either the technique should be altered, or acupuncture discontinued.

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

D.2.e.xiii.b Acupuncture for Acute, Subacute, or Post-Operative Epicondylalgia

Not Recommended - for the treatment of acute, subacute, or post-operative epicondylalgia.

Evidence for the Use of Acupuncture for Lateral Epicondylalgia

D.2.e.xiv Biofeedback, Electrical Nerve Stimulation, and Diathermy for Acute, Subacute, or Chronic Epicondylalgia

Not Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

Evidence for Biofeedback, Transcutaneous Electrical Nerve Stimulation, Electrical Stimulation, and Diathermy for Lateral Epicondylalgia

D.2.f Injections

D.2.f.i Glucocorticosteroid Injections

D.2.f.i.a Glucocorticosteroid Injections for Subacute or Chronic Epicondylalgia

Recommended - for the treatment of highly selective subacute or chronic epicondylalgia.

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

Frequency/Dose/Duration – All quality trials have performed one injection and assessed the results for a positive outcome prior to performing additional injections.

Indications for Discontinuation – Resolution of pain, intolerance, lack of efficacy or non-compliance. Lack of response should result in reassessment of the diagnosis.

D.2.f.i.b Glucocorticosteroid Injections for Acute Epicondylalgia

<u>Not Recommended</u> - for the treatment of acute epicondylalgia.

D.2.f.i.c Glucocorticosteroid Injections Using Bupivacaine for Subacute or Chronic Epicondylalgia

<u>Recommended</u> - as an adjunct for the treatment of subacute or chronic epicondylalgia.

Evidence for the Use of Glucocorticosteroid Injections for Lateral Epicondylalgia

D.2.f.ii Botulinum Injections for Acute, Subacute, or Chronic Lateral Epicondylalgia

<u>Not Recommended</u> - for the treatment of acute, subacute, or chronic lateral epicondylalgia.

Evidence for Use of Botulinum Injections for Lateral Epicondylalgia

D.2.f.iii Platelet Rich Plasma Injections

<u>Recommended</u> - for Chronic Lateral Epicondylalgia

Indications – Lateral epicondylalgia lasting at least 6 months, unresponsive to other treatments including NSAID(s), straps, stretching and strengthening exercises, and at least one glucocorticosteroid injection.

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

D.2.f.iv Autologous Blood Injections

Recommended - for Chronic Lateral Epicondylalgia

Indications – Lateral epicondylalgia lasting at least 6 months, unresponsive to other treatments including NSAID(s), straps, stretching and strengthening exercises, and at least one glucocorticosteroid injection.

Dose/Frequency – Withdrawal of 2mL of autologous blood from a peripheral vein, then injected into the most tender location(s).

D.2.f.v Platelet-rich Plasma or Autologous Blood Injections for Acute or Subacute Epicondylalgia

Not Recommended - for the treatment of acute or subacute epicondylalgia.

Evidence for the Use of Platelet-rich Plasma and Autologous Blood Injections for Epicondylalgia

D.2.f.vi Polidocanol Injections for Acute, Subacute, or Chronic Epicondylalgia

Not Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

Evidence for Use of Polidocanol Injections for Epicondylalgia

D.2.f.vii Periarticular Viscosupplementation (Hyaluronate and Glycosaminoglycan) Injections for Chronic Epicondylalgia

Not Recommended - for the treatment of chronic epicondylalgia.

Evidence for the Use of Periarticular Viscosupplementation Injections

D.2.f.viii Other Injections

D.2.f.viii.a Prolotherapy or Sonographically Guided Percutaneous Tenotomy Injections for Acute, Subacute, or Chronic Epicondylalgia

Not Recommended - for the treatment of acute, subacute, or chronic epicondylalgia.

D.2.f.viii.b Dry Needling or Multi Puncture Technique ('peppering") May Be Effective for Treatment of Subacute or Chronic Epicondylalgia

Recommended – for the treatment of subacute or chronic epicondylalgia

Rationale for Recommendations – There is some preliminary evidence that either dry needling or multiple puncuture technique ('peppering') may be effective.

D.2.g Surgical Considerations

Surgery has been used to treat lateral epicondylalgia that does not respond to adequate trials of nonoperative care. There are three main surgical approaches for lateral epicondylalgia – open, percutaneous, and arthroscopic. One review found no evidence of the superiority of one approach over another and concluded that the choice should be left to the individual surgeon.

D.2.g.i Lateral Epicondylar Release for Chronic Lateral Epicondylalgia

Recommended - for the treatment of chronic lateral epicondylalgia.

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

D.2.g.ii Radiofrequency Microtenotomy for Chronic Lateral Epicondylalgia

Recommended - for the treatment of chronic lateral epicondylalgia.

Indications – Same as above.

Evidence for the Use of Surgical Interventions for Epicondylalgia

D.3 Olecranon Bursitis

D.3.a Diagnostic Criteria

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

D.3.b Special Studies and Diagnostic and Treatment Considerations

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

D.3.b.i Fluid Aspiration of Swollen Bursa and Analyses for Olecranon Bursitis

Recommended – for a clinically infected or questionably infected bursa, including Gram stain, culture and sensitivity, and complete cell count, to determine infection for olecranon bursitis. Crystal examination (light polarizing microscopy) should also be performed at least once on the aspirated fluid.

Rationale for Recommendation - Aspiration has been used for diagnosis, particularly when combined with Gram stain, culture and sensitivity, and complete cell count of the aspirated fluid are performed. Crystal examination (light polarizing microscopy) should also be performed at least once on the aspirated fluid.

Evidence for the Use of Aspiration

D.3.b.ii X-Rays for Olecranon Bursitis

Recommended - to rule out osteomyelitis or joint effusion in cases of significant septic olecranon bursitis.

D.3.c Initial Care

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

D.3.c.i Soft Padding, Soft Elbow Supports, and Ace Wraps for Olecranon Bursitis

Recommended - for olecranon bursitis.

D.3.c.ii Modifying Activities to Avoid Direct Pressure Over the Olecranon

Recommended - allowing time to reabsorb the fluid are recommended.

D.3.d Medications

For most patients, ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Acetaminophen (or the analog paracetamol) may be a reasonable alternative to NSAIDs for patients who are not candidates for NSAIDs, although most evidence suggests acetaminophen is modestly less effective. There is evidence that NSAIDs are as effective for relief of pain as opioids (including tramadol) and less impairing.

D.3.d.i Non-Steroidal Anti-inflammatory Drugs (NSAIDs)

NSAIDs for Treatment of Acute, Subacute, Chronic, or Post-operative Olecranon Bursitis

Recommended - for treatment of acute, subacute, chronic, or post-operative Olecranon Bursitis.

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

Frequency/Duration – As needed use may be reasonable for many patients.

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

D.3.d.ii NSAIDs for Patients at High Risk of Gastrointestinal Bleeding.

Recommended – concomminent use of cytoprotective classes of drugs: misoprostol, sucralfate, histamine Type 2 receptor blockers, and proton pump inhibitors for patients at high risk of gastrointestinal bleeding.

*Indication*s – For patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications should be considered, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, elderly, diabetics, and cigarette smokers.

Frequency/Dose/Duration – Proton pump inhibitors, misoprostol, sucralfate, H2 blockers recommended. Dose and frequency per manufacturer. There is not generally believed to be substantial differences in efficacy for prevention of gastrointestinal bleeding.

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

D.3.d.iii NSAIDs for Patients at Risk for Cardiovascular Adverse Effects

Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed.

Recommended - Acetaminophen or aspirin as the first-line therapy appear to be the safest regarding cardiovascular adverse.

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

D.3.d.iv Acetaminophen for Treatment of Elbow Pain

Recommended - for treatment of elbow pain, particularly in patients with contraindications for NSAIDs.

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

Dose/Frequency – Per manufacturer's recommendations; may be utilized on an as-needed basis. There is evidence of hepatic toxicity when exceeding four gm/day.

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

Evidence for the Use of NSAIDs for Olecranon Bursitis

D.3.e Injection Therapies

Glucocorticosteroid Injections for Olecranon Bursitis

Not Recommended - for the treatment of olecranon bursitis.

Evidence for the Use of Glucocorticosteroid Injections for Olecranon Bursitis

D.3.f Surgical Considerations

Surgery has been widely used to treat olecranon bursitis that has not responded to activity modifications and other conservative measures including but not limited to; rest, ice, compression, elevation (RICE), heat, PT or a home exercise program.

D.3.f.i Surgical Drainage for Olecranon Bursitis

Recommended - for treatment of olecranon bursitis.

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

D.3.f.ii Surgical Resection for Chronic Olecranon Bursitis

Recommended - for chronic olecranon bursitis with recurrent drainage.

Indications – Olecranon bursitis with recurrent drainage.

D.4 Elbow Fractures, including Non-Displaced Radial Head Fractures

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

D.4.a Diagnostic Criteria

A clinical impression is made upon history of appropriate injury mechanism and physical examination findings of substantial tenderness particularly focally over a bone. Findings of (in)ability to use the elbow should be sought, as well as inspection for signs of deformity. A fracture identified on x-rays, generally two or three views, confirms that diagnostic impression. The differential diagnosis prominently includes elbow sprain and dislocation. If x-rays are negative and clinical suspicion high, a CT is usually the next test.

D.4.b Special Studies and Diagnostic and Treatment Considerations

X-rays for Elbow Fracture

Recommended - X-rays that include at least two to three views are recommended to diagnose elbow fractures.

D.4.c Initial Care

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

D.4.c.i Elbow Slings for Non-displaced and Occult Radial Head Fractures

Recommended - for treatment of non-displaced and occult radial head fractures.

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

Frequency/Duration – Sling (or splint) use for non-displaced radial head fractures is for seven days. (A shorter complete immobilization period of as little as three days may be used for non-displaced fractures that are clinically present but not visible on an x-ray.) After seven days, gentle range-of-motion exercises within pain tolerance should begin, followed by progressive mobilization.

D.4.c.ii Casts and Cast Bracing for Select Elbow Fractures

Recommended - for treatment of non-displaced or occult radial head fractures.

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

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

Evidence for the Use of Immobilization for Elbow Fractures

D.4.d Medications

For most patients, ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Acetaminophen (or the analog paracetamol) may be a reasonable alternative to NSAIDs for patients who are not candidates for NSAIDs, although most evidence suggests acetaminophen is modestly less effective. There is evidence that NSAIDs are as effective for relief of pain as opioids (including tramadol) and less impairing.

D.4.d.i Non-Steroidal Anti-inflammatory Drugs (NSAIDs) for Treatment of Acute, Subacute, Chronic, or Post-Operative Elbow Fractures

Recommended - for treatment of acute, subacute, chronic, or post-operative Elbow Fractures.

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

Frequency/Duration – There is no quality evidence one NSAID is superior to another for these indications. As needed use may be reasonable for many patients.

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

D.4.d.ii NSAIDs for Patients at High Risk of Gastrointestinal Bleeding.

Recommended – concomminent use of cytoprotective classes of drugs: misoprostol, sucralfate, histamine Type 2 receptor blockers, and proton pump inhibitors for patients at high risk of gastrointestinal bleeding.

*Indication*s – For patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications should be considered, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, elderly, diabetics, and cigarette smokers.

Frequency/Dose/Duration – Proton pump inhibitors, misoprostol, sucralfate, H2 blockers recommended. Dose and frequency per manufacturer. There is not generally believed to be substantial differences in efficacy for prevention of gastrointestinal bleeding.

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

D.4.d.iii NSAIDs for Patients at Risk for Cardiovascular Adverse Effects

Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed.

Recommended - Acetaminophen or aspirin as the first-line therapy appear to be the safest regarding cardiovascular adverse.

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

D.4.d.iv Acetaminophen for Treatment of Elbow Pain

Recommended - for treatment of elbow pain, particularly in patients with contraindications for NSAIDs.

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

Dose/Frequency – Per manufacturer’s recommendations; may be utilized on an as-needed basis. There is evidence of hepatic toxicity when exceeding four gm/day.

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

D.4.d.v Opioids for Select Patients with Pain from Elbow Fractures

Recommended - for treatment of select patients with pain from elbow fractures.

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

Frequency/Dose – As needed. For the few patients requiring opioids, the majority need at most a few days treatment to not more than one week and then generally have insufficient pain for further treatment with opioids.

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

Evidence for the Use of Opioids for Elbow Fractures

D.4.e Surgery

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

Surgical Fixation of Displaced Elbow Fractures

Recommended - Surgical fixation is recommended for displaced elbow fractures.

Evidence for the Use of Surgery for Elbow Fractures

D.4.f Therapeutic Exercise (Active and Passive)

Rehabilitation (supervised formal therapy) required as a result of a work-related injury should be focused on restoring functional ability required to meet the patient’s daily and work activities and return to work; striving to restore the injured worker to pre-injury status in so far as is feasible.

Active therapy requires an internal effort by the patient to complete a specific exercise or task. Passive therapy are those interventions not requiring the exertion of effort on the part of the patient, but rather are dependent on modalities delivered by a therapist. Generally passive interventions are viewed as a means to facilitate progress in an active therapy program with concomitant attainment of objective functional gains. Active interventions should be emphasized over passive interventions.

The patient should be instructed to continue both active and passive therapies at home as an extension of the treatment process in order to maintain improvement levels.

Assistive devices may be included as an adjunctive measure incorporated into the rehabilitation plan to facilitate functional gains.

D.4.f.i Physical or Occupational Therapy of Patients After Cast Removal

Recommended – after cast removal.

Frequency/Dose/Duration –Total numbers of visits may be as few as two to three for patients with mild functional deficits or up to 12 to 15 with more severe deficits with documentation of ongoing objective functional improvement.

When there are ongoing functional deficits, more than 12 to 15 visits may be indicated if there is documentation of functional improvement towards specific objective functional goals (e.g., increased grip strength, key pinch strength, range of motion, advancing ability to perform work activities). As part of the rehabilitation plan a home exercise program should be developed and performed in conjunction with the therapy.

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

D.5 Elbow Dislocations

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

D.5.a Diagnostic Criteria

Dislocations are diagnosed based on a combination of typical inciting event (usually fall or trauma) combined with deformity and inability to use the arm. Persistent dislocation involves a complete inability to use the arm and deformity.

D.5.b Special Studies and Diagnostic and Treatment Considerations

X-Rays

Recommended - at least two to three views for elbow dislocation to rule-out fractures. Repeat x-rays after reduction are also recommended.

D.5.c Initial Care

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

D.5.c.i General Anesthesia to Facilitate Reduction in Select Patients

Recommended - to facilitate reduction in select patients.

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

Rationale for Recommendation - Most patients do not require general anesthesia to obtain sufficient muscular relaxation for reduction. In cases where reduction is not obtained and intraarticular injection with anesthetics is insufficient to obtain reduction, general anesthesia is used and is therefore recommended when other measures fail.

D.5.d Monitoring Progress

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

D.5.e Activity Modification and Exercise

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

D.5.f Medications

For most patients, ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Acetaminophen (or the analog paracetamol) may be a reasonable alternative to NSAIDs for patients who are not candidates for NSAIDs, although most evidence suggests acetaminophen is modestly less effective. There is evidence that NSAIDs are as effective for relief of pain as opioids (including tramadol) and less impairing.

D.5.f.i Non-Steroidal Anti-inflammatory Drugs (NSAIDs)

NSAIDs for Treatment of Elbow Dislocation or Post-Operative Elbow Reduction

Recommended - for treatment of Elbow Dislocation, or post-operative Elbow Reduction.

Indications – For Elbow Dislocation, or post-operative Elbow Reduction, NSAIDs are recommended for treatment. Over-the-counter (OTC) agents may suffice and should be tried first.

Frequency/Duration – As needed use may be reasonable for many patients.

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

D.5.f.ii NSAIDs for Patients at High Risk of Gastrointestinal Bleeding.

Recommended – concomminent use of cytoprotective classes of drugs: misoprostol, sucralfate, histamine Type 2 receptor blockers, and proton pump inhibitors for patients at high risk of gastrointestinal bleeding.

*Indication*s – For patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications should be considered, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, elderly, diabetics, and cigarette smokers.

Frequency/Dose/Duration – Proton pump inhibitors, misoprostol, sucralfate, H2 blockers recommended. Dose and frequency per manufacturer. There is not generally believed to be substantial differences in efficacy for prevention of gastrointestinal bleeding.

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

D.5.f.iii NSAIDS for Patients at Risk for Cardiovascular Adverse Effects
Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed.

Recommended - Acetaminophen or aspirin as the first-line therapy appear to be the safest regarding cardiovascular adverse.

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

D.5.f.iv Acetaminophen for Treatment of Elbow Pain

Recommended - for treatment of elbow pain, particularly in patients with contraindications for NSAIDs.

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

Dose/Frequency – Per manufacturer's recommendations; may be utilized on an as-needed basis. There is evidence of hepatic toxicity when exceeding four gm/day.

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

Evidence for the Use of NSAIDs and Acetaminophen for Elbow Dislocation

D.5.f.v Opioids

Recommended - for treatment of select patients with pain from elbow dislocations.

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

Frequency/Dose – As needed dosing. Among the few patients requiring opioids, most require at most a few days to not more than one week of treatment and then generally have insufficient pain for further treatment with opioids.

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

Rationale for Recommendation - Most patients do not require opioids. Some patients, particularly with more severe dislocations may require opioids.

Evidence for the Use of Opioids for Elbow Dislocation

D.5.f.vi Anesthetic Intraarticular Injections for Pre- or Post-Reduction Pain

Recommended - either pre-reduction or post-reduction for pain management.

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

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

Rationale for Recommendation - Most patients do not require intraarticular anesthetic injections. Some require these injections to assist with obtaining sufficient pain relief to facilitate reduction and thus avoid general anesthesia. Some require these injections after reduction for pain control. Generally, pre-reduction injections utilize more short-term anesthetics and post-reduction injections utilize longer lasting anesthetics. These injections are recommended to facilitate reduction and/or pain control.

Evidence for the Use of Anesthetic Intraarticular Injections

D.5.g Physical Methods/Devices

Posterior Elbow Splint and Sling for Dislocated Elbow

Recommended – for treatment of dislocated elbows.

Indications – Dislocated elbows after reduction.

Duration- Posterior splints are usually applied for approximately 10-17 days. Range of motion exercises are recommended after immobilization.

D.5.h Surgery

Surgery may be required to repair ligaments if there is either sufficient laxity that recurrent dislocations occur or are otherwise unstable.

Surgery for Elbow Joints That Recurrently Dislocate or Are Unstable After Dislocation

Recommended - to repair elbow joints that either recurrently dislocate or are otherwise unstable after dislocation(s).

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

Rationale for Recommendation - Most patients do not require surgical repair after elbow dislocation. However, some have unstable joints due to ligament and/or capsular damage and laxity. Others have recurrent dislocations. Surgical repair is successful in some to improve or resolve these issues and is recommended for select patients.

Evidence for the Use of Immobilization and Surgery

D.6 Elbow Lacerations

See Hand, Wrist, and Forearm Injuries Medical Treatment Guideline.

D.7 Elbow Sprains

An isolated elbow sprain is relatively uncommon and is caused by a significant high-force trauma, resulting in a disruption of ligament(s) about the elbow. The most common mechanism is a fall. Generally, a sprain is accompanied by other problems such as fracture, dislocation, or contusion.

Potential complications need to be evaluated including the motor, sensory, and vascular systems. Such an evaluation is required to rule-out accompanying injury(ies).

For the medical management of dislocation of the elbow, an x-ray should be taken to assure that there is no fracture. Other than mild sprains, medical management of the sprained elbow should generally include an x-ray to assure that there is no fracture.

D.7.a Diagnostic Studies

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

D.7.a.i Special Studies and Diagnostic and Treatment Considerations X-rays for Elbow Sprain

Recommended - at least two to three views to rule-out fractures. Repeat x-rays are also recommended if there is failure to improve as clinically expected over approximately a week.

D.7.a.ii Monitoring Progress

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

D.7.e Medications

For most patients, ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Acetaminophen (or the analog paracetamol) may be a reasonable alternative to NSAIDs for patients who are not candidates for NSAIDs, although most evidence suggests acetaminophen is modestly less effective. There is evidence that NSAIDs are as effective for relief of pain as opioids (including tramadol) and less impairing.

D.7.e.i Non-Steroidal Anti-inflammatory Drugs (NSAIDs) NSAIDs for Treatment of Elbow Sprains

Recommended - for treatment of Elbow Sprains.

Indications – For Sprains, NSAIDs are recommended for treatment. Over-the-counter (OTC) agents may suffice and should be tried first.

Frequency/Duration – As needed use may be reasonable for many patients.

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

D.7.e.ii NSAIDs for Patients at High Risk of Gastrointestinal Bleeding.

Recommended – concomminent use of cytoprotective classes of drugs: misoprostol, sucralfate, histamine Type 2 receptor blockers, and proton pump inhibitors for patients at high risk of gastrointestinal bleeding.

*Indication*s – For patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications should be considered, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, elderly, diabetics, and cigarette smokers.

Frequency/Dose/Duration – Proton pump inhibitors, misoprostol, sucralfate, H2 blockers recommended. Dose and frequency per manufacturer. There is not generally believed to be substantial differences in efficacy for prevention of gastrointestinal bleeding.

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

D.7.e.iii NSAIDs for Patients at Risk for Cardiovascular Adverse Effects
Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed.

Recommended - Acetaminophen or aspirin as the first-line therapy appear to be the safest regarding cardiovascular adverse.

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

D.7.e.iv Acetaminophen for Treatment of Elbow Pain

Recommended - for treatment of elbow pain, particularly in patients with contraindications for NSAIDs.

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

Dose/Frequency – Per manufacturer's recommendations; may be utilized on an as-needed basis. There is evidence of hepatic toxicity when exceeding four gm/day.

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

D.7.e.v Opioids for Select Patients with Elbow Sprains

Recommended - for the treatment of select patients with pain from severe elbow sprains.

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

Frequency/Dose – As needed dosing. Among the few patients requiring opioids, most require at most a few days to not more than one week of treatment and then generally have insufficient pain for further treatment with opioids.

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

Rationale for Recommendation - Most patients do not require opioids. Some patients, particularly with more severe sprains may require opioids. They are recommended for limited duration (not more than one week) use in select patients with elbow sprains.

Evidence for the Use of Opioids for Elbow Sprains

D.7.f Treatments

D.7.f.i Rehabilitation / Devices

Slings for Elbow Sprains

Recommended - for the treatment of elbow sprains.

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

Evidence for the Use of Slings for Elbow Sprains

D.7.f.ii Activity Modification and Exercise

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

D.8 Biceps Tendinosis (or Tendinitis) and Tears/Ruptures

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

D.8.a Diagnostic Criteria

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

D.8.b Diagnostic Studies

D.8.b.i X-Rays

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

X-rays for Biceps Tendinosis or Ruptures

Recommended - for biceps tendinosis or ruptures.

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

D.8.b.ii MRI for Biceps Tendinosis or Ruptures

Recommended - for biceps tendinosis or ruptures.

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

D.8.b.iii Ultrasound

Diagnostic Ultrasound for Biceps Tendinosis or Ruptures

Recommended - for the evaluation and diagnosis of biceps tendinosis or ruptures.

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

Rationale for Recommendation - After MRI, diagnostic ultrasound is likely the second most common imaging study to evaluate the degree of biceps tendinosis or rupture. Ultrasound may assist in evaluating the need for surgery particularly in those patients with moderately severe tears in whom the degree of rupture may help identify whether surgery is likely to be beneficial.

D.8.c Medications

For most patients, ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Acetaminophen (or the analog paracetamol) may be a reasonable alternative to NSAIDs for patients who are not candidates for NSAIDs, although most evidence suggests acetaminophen is modestly less effective. There is evidence that NSAIDs are as effective for relief of pain as opioids (including tramadol) and less impairing.

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D.8.c.i Non-Steroidal Anti-inflammatory Drugs (NSAIDs) for Treatment of

Biceps Tendinosis and Tears

Recommended - for treatment of Biceps Tendinosis and Tears

Indications – For Biceps Tendinosis and Tears, NSAIDs are recommended for treatment. Over-the-counter (OTC) agents may suffice and should be tried first.

Frequency/Duration – As needed use may be reasonable for many patients.

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

D.8.c.ii NSAIDs for Patients at High Risk of Gastrointestinal Bleeding.

Recommended – concomminent use of cytoprotective classes of drugs: misoprostol, sucralfate, histamine Type 2 receptor blockers, and proton pump inhibitors for patients at high risk of gastrointestinal bleeding.

*Indication*s – For patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications should be considered, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, elderly, diabetics, and cigarette smokers.

Frequency/Dose/Duration – Proton pump inhibitors, misoprostol, sucralfate, H2 blockers recommended. Dose and frequency per manufacturer. There is not generally believed to be substantial differences in efficacy for prevention of gastrointestinal bleeding.

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

D.8.c.iii NSAIDs for Patients at Risk for Cardiovascular Adverse Effects

Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed.

Recommended - Acetaminophen or aspirin as the first-line therapy appear to be the safest regarding cardiovascular adverse.

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

D.8.c.iv Acetaminophen for Treatment of Elbow Pain

Recommended - for treatment of elbow pain, particularly in patients with contraindications for NSAIDs.

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

Dose/Frequency – Per manufacturer's recommendations; may be utilized on an as-needed basis. There is evidence of hepatic toxicity when exceeding four gm/day.

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

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

D.8.c.v Opioids for Select Patients with Biceps Tendinosis

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

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

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

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

Rationale for Recommendation - Many patients will require a few days of treatment to not more than one week with opioids in the acute post-operative period, while non-operative patients do not generally require opioids. Patients with moderately severe to severe biceps tendinosis or inadequate control with NSAIDs may require opioids. They are recommended for limited duration (not more than one week) use in select patients.

Evidence for the Use of Opioids for Biceps Tendinosis

D.8.d Treatments

D.8.d.i Initial Care

Patients with severe or complete ruptures should be referred to a surgeon to evaluate the need for surgical repair. Other patients should receive treatment including activity limitations and pain management strategies generally centering on NSAIDs.

D.8.d.i.a Monitoring Progress

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

D.8.d.ii Rehabilitation: Devices / Therapy

Rehabilitation (supervised formal therapy) required as a result of a work-related injury should be focused on restoring functional ability required to meet the patient's daily and work activities and return to work; striving to restore the injured worker to pre-injury status in so far as is feasible.

Active therapy requires an internal effort by the patient to complete a specific exercise or task. Passive therapy are those interventions not requiring the exertion of effort on the part of the patient, but rather are dependent on modalities delivered by a therapist. Generally passive interventions are viewed as a means to facilitate progress in an active therapy program with concomitant attainment of objective functional gains. Active interventions should be emphasized over passive interventions.

The patient should be instructed to continue both active and passive therapies at home as an extension of the treatment process in order to maintain improvement levels.

Assistive devices may be included as an adjunctive measure incorporated into the rehabilitation plan to facilitate functional gains.

D.8.d.ii.a Exercise

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

Therapy (Active)

D.8.d.ii.b Exercises for Biceps Tendinosis, Ruptures, or Post-Operative Patients

<u>Recommended</u> - strengthening exercises for treatment of biceps tendinosis, ruptures and post-operative patients.

Indications – All biceps tendinosis patients are candidates.

Frequency/Dose/Duration –Total numbers of visits may be as few as two to three for patients with mild functional deficits or up to 12 to 15 with more severe deficits with documentation of ongoing objective functional improvement.

When there are ongoing functional deficits, more than 12 to 15 visits may be indicated if there is documentation of functional improvement towards specific objective functional goals (e.g., increased grip strength, key pinch strength, range of motion, advancing ability to perform work activities). As part of the rehabilitation plan a home exercise program should be developed and performed in conjunction with the therapy.

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Duration – Varies widely depending on severity, preinjury conditioning and job demands.

Devices

D.8.d.ii.c Slings and Splints for Biceps Tendinosis, Ruptures and Post-Operative Patients

Recommended - for the treatment of biceps tendinosis, ruptures, and post-operative patients.

Indications – Moderate to severely affected patients, especially for the first week. Post-operative patients also usually treated with posterior splints for approximately two weeks (range one to six weeks).

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

D.8.e Surgery

Biceps tendinosis may be severe enough to involve a biceps rupture. These recommendations are for a distal biceps tendon rupture, not a (proximal) bicipital tendon rupture, which occurs in the bicipital groove at the shoulder and often does not require surgery. Distal biceps tendon ruptures can be managed non-operatively and some authors note non-operative management continues to be acceptable for some, particularly if there are low job demands or older patients. However, distal biceps ruptures generally occur in the setting of supramaximal use of force and requires surgical repair in most employed patients. Operative approaches include single-incision, dual-incision, and endoscopic.

D.8.e.i Surgical Repair for Distal Biceps Ruptures

Recommended - surgical repair of distal biceps ruptures.

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

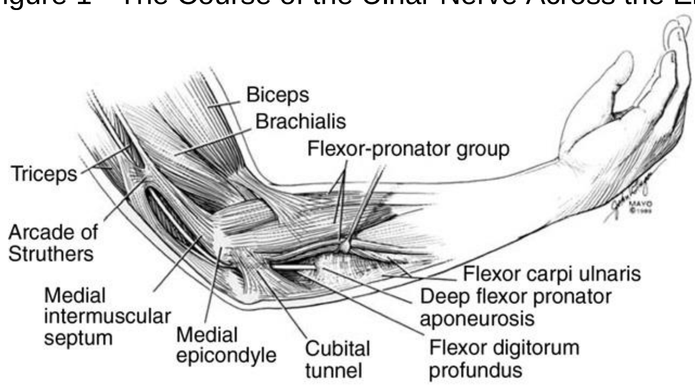
D.9 Triceps Tendinosis (or Tendinitis) and Tears/Ruptures

Triceps tendinosis (or tendinitis) is a true muscle strain involving the muscle-tendon junction of the triceps. It is believed to be analogous to biceps tendinosis, including high force mechanism of injury.

D.10 Ulnar Neuropathies at the Elbow; Including Condylar Groove Associated Ulnar Neuropathy and Cubital Tunnel Syndrome

Although it is possible to entrap a nerve at any point along its course, there are two common areas for entrapment of the ulnar nerve at the elbow. The first is in the condylar groove, and the second begins immediately distal to the elbow joint in the true, anatomic cubital tunnel. This tunnel commences as the ulnar nerve begins to traverse distally beneath the aponeurosis.

Figure 1 **-** The Course of the Ulnar Nerve Across the Elbow



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

Proper testing to localize the abnormality involves a nerve conduction study that includes at least stimulation above and below the elbow. The role for the "inching technique" to isolate the location of the nerve conduction velocity decrement and infer the precise location of the entrapment, while recommended by the American Academy of Electrodiagnostic Medicine and logical for its importance to treatment has not been delineated in quality interventional studies. (Cubital tunnel syndrome should theoretically be amenable to treatment with simple decompression. Ulnar neuropathies in the condylar groove should theoretically be less amenable to simple (aka "in situ") decompression.)

Aside from surgical studies, there are no quality studies on which to rely for treatment of ulnar neuropathies, and there is little quality evidence of benefits of treatment options.

D.10.a Initial Care

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

D.10.a.i Position of Elbows During Sleep

Recommended - that patients be taught to sleep with their elbows extended, rather than flexed.

D.10.a.ii Elbow Posture During Work or Avocational Activities

Recommended - to avoid hyperflexed (>90º) elbow postures at work (or during avocational activities).

D.10.b Diagnostic Criteria

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

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

D.10.b.i Special Studies and Diagnostic and Treatment Considerations

D.10.b.i.a Electrodiagnostic Studies

Electromyography for Diagnosing Subacute or Chronic Peripheral Nerve Entrapments

Recommended - to assist in the diagnosis of subacute or chronic peripheral nerve entrapments including ulnar neuropathies, radial neuropathies and median neuropathies.

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

D.10.b.i.b EDS for Diagnosis and Pre-Operative Assessment of Peripheral Nerve Entrapments

Recommended - to assist in securing a firm diagnosis for those patients without a clear diagnosis. EDS are also recommended as one of two methods to attempt to objectively secure a diagnosis prior to surgical release.

D.10.b.i.c EDS for Initial Evaluation of Patients Suspected of Having a Peripheral Nerve Entrapment

Not Recommended - for initial evaluation of most patients as it does not change the management of the condition and other interventions are believed to be efficacious.

D.10.b.i.d Ultrasound and MRI

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

Diagnostic Ultrasound and MRI for Evaluation and Diagnosis of Ulnar Neuropathies at the Elbow

Not Recommended - for the evaluation and diagnosis of ulnar neuropathies at the elbow.

D.10.c Medications

For most patients, ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Acetaminophen (or the analog paracetamol) may be a reasonable alternative to NSAIDs for patients who are not candidates for NSAIDs, although most evidence suggests acetaminophen is modestly less effective. There is evidence that NSAIDs are as effective for relief of pain as opioids (including tramadol) and less impairing.

D.10.c.i Non-Steroidal Anti-inflammatory Drugs (NSAIDs)

Recommended - for treatment of acute, subacute, chronic or post operative Ulnar Neuropathies

Indications – For acute, subacute, chronic or post operative Ulnar Neuropathies, NSAIDs are recommended for treatment. Over-the-counter (OTC) agents may suffice and should be tried first. For patients having ulnar neuropathy surgical release, generally treat two to six weeks post operative.

Frequency/Duration - As needed use may be reasonable for many patients.

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

D.10.c.ii NSAIDs for Patients at High Risk of Gastrointestinal Bleeding.

Recommended – concomminent use of cytoprotective classes of drugs: misoprostol, sucralfate, histamine Type 2 receptor blockers, and proton pump inhibitors for patients at high risk of gastrointestinal bleeding.

*Indication*s – For patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications should be considered, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, elderly, diabetics, and cigarette smokers.

Frequency/Dose/Duration – Proton pump inhibitors, misoprostol, sucralfate, H2 blockers recommended. Dose and frequency per manufacturer. There is not generally believed to be substantial differences in efficacy for prevention of gastrointestinal bleeding.

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

D.10.c.iii NSAIDs for Patients at Risk for Cardiovascular Adverse Effects

Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed.

Recommended - Acetaminophen or aspirin as the first-line therapy appear to be the safest regarding cardiovascular adverse.

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

D.10.c.iv Acetaminophen for Treatment of Elbow Pain

Recommended - for treatment of elbow pain, particularly in patients with contraindications for NSAIDs.

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

Dose/Frequency – Per manufacturer's recommendations; may be utilized on an as-needed basis. There is evidence of hepatic toxicity when exceeding four gm/day.

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

D.10.c.v Opioids

Opioids have occasionally been used to treat pain for patients with ulnar neuropathies at the elbow. These medications have primarily been used for a few nights in the post-surgical timeframe.

D.10.c.v.a Routine Use of Opioids for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathies

Not Recommended - for the treatment of acute, subacute, or chronic ulnar neuropathies at the elbow.

Rationale for Recommendations - There are no quality studies evaluating opioids for treating ulnar neuropathies. Opioids cause significant adverse effects – poor tolerance, constipation, drowsiness, clouded judgment, memory loss, and potential misuse or dependence have been reported in up to 35% of patients. Before prescribing opioids, patients should be informed of these potential adverse effects and cautioned against operating motor vehicles or machinery. Opioids do not appear to be more effective than safer analgesics for managing most musculoskeletal symptoms; they should only be used if needed for severe pain or for a short time (not more than one week) in the post-operative time. Opioids are not recommended for treatment of ulnar neuropathy, except as a brief post-operative course.

D.10.c.v.b Use of Opioids for Treatment of Select Post-Operative Ulnar Neuropathy Patients

Recommended - for a few days to not more than one week for select patients who have undergone recent ulnar neuropathy surgery, particularly if complications have occurred.

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

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

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

Rationale for Recommendations - Transposition patients have larger incisions and frequently require post-operative opioids for at least a few days, usually in addition to NSAIDs. Some require these medications for a longer time. Opioids are recommended for brief (not more than one week), select use in post-operative patients with primary use at night to achieve sleep post-operatively.

Glucocorticosteroids (AKA "Steroids")
Oral and Injections (condylar groove or cubital tunnel)

D.10.c.vi Glucocorticosteroids (Oral or Injections) for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathies at the Elbow

Not Recommended - for the treatment of acute, subacute, or chronic ulnar neuropathies at the elbow. There is no indication for injecting steroids into the cubital tunnel as is done for the carpal tunnel as there is no other structure than the ulnar nerve in the tunnel and steroid injection into the nerve may cause damage.

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

D.10.c.vii Vitamins, Including Pyridoxine, for Acute, Subacute or Chronic Ulnar Neuropathies

Not Recommended - for routine treatment of acute, subacute, or chronic ulnar neuropathies in patients without vitamin deficiencies.

D.10.c.viii Lidocaine Patches for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathies

Not Recommended - for treatment of acute, subacute, or chronic ulnar neuropathies with pain.

D.10.c.ix Ketamine for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathies

Not Recommended - for treatment of acute, subacute, or chronic ulnar neuropathies with pain.

D.10.d Treatments

D.10.d.i Rehabilitation: Devices / Therapy

Rehabilitation (supervised formal therapy) required as a result of a work-related injury should be focused on restoring functional ability required to meet the patient's daily and work activities and return to work; striving to restore the injured worker to pre-injury status in so far as is feasible.

Active therapy requires an internal effort by the patient to complete a specific exercise or task. Passive therapy are those interventions not requiring the exertion of effort on the part of the patient, but rather are dependent on modalities delivered by a therapist. Generally passive interventions are viewed as a means to facilitate progress in an active therapy program with concomitant attainment of objective functional gains. Active interventions should be emphasized over passive interventions.

The patient should be instructed to continue both active and passive therapies at home as an extension of the treatment process in order to maintain improvement levels.

Assistive devices may be included as an adjunctive measure incorporated into the rehabilitation plan to facilitate functional gains.

D.10.d.ii Activity Modification and Exercise

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

Devices

D.10.d.iii Magnets for Management of Pain From Acute, Subacute, or Chronic Ulnar Neuropathies

Not Recommended - for the management of pain for acute, subacute, or chronic ulnar neuropathies.

D.10.d.iv Nocturnal Elbow Splinting for Treatment of Acute, Subacute, or Chronic Ulnar Neuropathies

Recommended - for treatment of acute, subacute, or chronic ulnar neuropathies at the elbow.

Indications – Symptoms consistent with ulnar neuropathy at the elbow, either condylar groove or cubital tunnel

Frequency/Dose – Elbow splints or braces are recommended to be worn while sleeping (range of 45-70 degrees used).

Indications for Discontinuation – Splints should be re-evaluated and potentially re-adjusted if no response within 2 weeks of starting treatment, particularly to assure that the patient is wearing them properly as well as to assess fit. If there is no improvement, splints should be discontinued and the accuracy of the diagnosis re-evaluated.

Evidence for the Use of Nocturnal Elbow Splinting

D.10.d.v Therapeutic Exercise - Physical / Occupational Therapy

Physical or Occupational Therapy for Acute, Subacute, Chronic, or Post Operative Ulnar Neuropahty

Recommended - for the treatment of acute, subacute, chronic, or post-operative ulnar neuropathy.

Frequency/Dose/Duration –Total numbers of visits may be as few as two to three for patients with mild functional deficits or up to 12 to 15 with more severe deficits with documentation of ongoing objective functional improvement.

When there are ongoing functional deficits, more than 12 to 15 visits may be indicated if there is documentation of functional improvement towards specific objective functional goals (e.g., increased grip strength, key pinch strength, range of motion, advancing ability to perform work activities). As part of the rehabilitation plan a home exercise program should be developed and performed in conjunction with the therapy.

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

Passive

D.10.d.vi Low-Level Laser Therapy for Acute, Subacute, or Chronic Ulnar Neuropathies

Not Recommended - for the treatment of acute, subacute, or chronic ulnar neuropathies.

D.10.d.vii Ultrasound for Acute, Subacute, or Chronic Ulnar Neuropathies

Recommended - for the treatment of acute, subacute, or chronic ulnar neuropathies.

Indications – Ulnar neuropathies that are sufficiently symptomatic to warrant treatment. Patients should generally be given nocturnal splints and had an inadequate response.

Indications for Discontinuation – Resolution, failure to objectively improve or intolerance.

Other

D.10.d.viii Acupuncture, Biofeedback, Manipulation and Mobilizaiton, Massage, Soft Tissue Massage, Iontophoresis, Phonophoresis

Not Recommended - for the treatment of acute, subacute, or chronic ulnar neuropathies at the elbow.

D.10.e Surgery

Ulnar Nerve Surgeries (Simple Release, Transpositions, Medial Epicondylectomy)

There are several surgical procedures for treatment of ulnar neuropathy at the elbow.

Referral for surgery may be indicated for patients who have red flags of a serious nature (e.g., compressive neuropathy secondary to acute fracture), or have failed to respond to non-surgical management including elbow posture modifications. Surgical considerations depend on the confirmed diagnosis of the presenting symptoms. If surgery is a consideration, counseling regarding likely outcomes, risks, and benefits, and especially expectations is important. It is also important to set pre-operative expectations that there is a necessity to adhere to the rehabilitative exercise regimen and work through post-operative pain. In the post-operative phase, range-of-motion exercises should involve the elbow, as well as the wrist and shoulder to avoid frozen shoulder (“adhesive capsulitis”)

D.10.e.i Surgical Release for Treatment of Subacute or Chronic Ulnar Neuropathies

Decompression, anterior subcutaneous transposition and medial epicondylectomy

Recommended - for patients who fail non-operative treatment for subacute or chronic ulnar neuropathies or patients who have emergent or urgent indications (e.g., acute compression due to fracture, arthritides or compartment syndrome with unrelenting symptoms of nerve impairment).

Indications – Symptoms of ulnar neuropathy at the elbow, and a significant loss of function, as reflected in significant activity limitations due to the nerve entrapment and that the patient has failed non-operative care usually for at least three months. Patients should generally have failed avoiding nerve irritation at night by preventing prolonged elbow flexion while sleeping, workstation changes to avoid elbow hyperflexion, full compliance in therapy, use of elbow pads, and removing opportunities to rest the elbow on the ulnar groove. Patients with severe symptoms such as continuous tingling and numbness, progression of symptoms or functional impairment may be earlier surgical candidates. Many surgeons will not operate on a patient without a positive electrodiagnostic study. Ideally, the EDS should include inching technique. Conditions of inflammatory nature may take many months to heal and the timing of a surgical consultation referral should take into consideration the normal healing time. The type of surgical procedure selected is dependent on factors that include the preoperative

EDS, surgeon's comfort and experience and surgical anatomy. Generally, a simple decompression is preferred over other procedures for true cubital tunnel syndrome.

D.10.e.ii Surgical Release for Treatment of Subacute or Chronic Ulnar Neuropathies (Anterior submuscular transposition)

Not Recommended – anterior submuscular transposition for the treatment of subacute or chronic ulnar neuropathies

Evidence for the Use of Surgery for Ulnar Neuropathy

D.11 Radial Nerve Entrapment (Including Radial Tunnel Syndrome)

Radial nerve entrapment, particularly of the posterior interosseous branch of the radial nerve, causes proximal forearm aching and pain that persists despite presumably effective treatment. It is clinically somewhat difficult to distinguish from non-specific forearm and elbow pain, is considered controversial, and it is sometimes referred to as "resistant tennis elbow" or "supinator syndrome." A relatively rare condition, radial nerve entrapment is estimated to be approximately 30 to 100 fold less common than carpal tunnel syndrome. There are multiple sites for potential entrapment. Most commonly, these sites include the extensor carpi radialis brevis origin, fibrous bands overlying the radial head, radial recurrent arterial fan, and the arcade of Frohse at the entrance to the supinator muscle.
A confirmatory electrodiagnostic motor study is helpful (often difficult to obtain) and is recommended.

In the absence of quality evidence for treatment of these radiculopathies, it is recommended that the treatments for ulnar neuropathy at the elbow (summarized below) be used to infer treatment for radial neuropathies.

D.11.a Medications

For most patients, ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Acetaminophen (or the analog paracetamol) may be a reasonable alternative to NSAIDs for patients who are not candidates for NSAIDs, although most evidence suggests acetaminophen is modestly less effective. There is evidence that NSAIDs are as effective for relief of pain as opioids (including tramadol) and less impairing.

D.11.a.i Non-Steroidal Anti-inflammatory Drugs (NSAIDs) for Treatment of Acute, Subacute, Chronic, or Post-Operative Pronator Syndrome Pain

Recommended - for treatment of acute, subacute, chronic, or post-operative Pronator Syndrome pain

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

Frequency/Duration – As needed use may be reasonable for many patients.

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

D.11.a.ii NSAIDs for Patients at High Risk of Gastrointestinal Bleeding.

Recommended – concomminent use of cytoprotective classes of drugs: misoprostol, sucralfate, histamine Type 2 receptor blockers, and proton pump inhibitors for patients at high risk of gastrointestinal bleeding.

*Indication*s – For patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications should be considered, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, elderly, diabetics, and cigarette smokers.

Frequency/Dose/Duration – Proton pump inhibitors, misoprostol, sucralfate, H2 blockers recommended. Dose and frequency per manufacturer. There is not generally believed to be substantial differences in efficacy for prevention of gastrointestinal bleeding.

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

D.11.a.iii NSAIDs for Patients at Risk for Cardiovascular Adverse Effects

Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed.

Recommended - Acetaminophen or aspirin as the first-line therapy appear to be the safest regarding cardiovascular adverse.

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

D.11.a.iv Acetaminophen for Treatment of Elbow Pain

Recommended - for treatment of elbow pain, particularly in patients with contraindications for NSAIDs.

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

Dose/Frequency – Per manufacturer's recommendations; may be utilized on an as-needed basis. There is evidence of hepatic toxicity when exceeding four gm/day.

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

D.11.a.v Glucocorticosteroids – Oral or Injections

Not Recommended – for acute, subacute, or chronic radial nerve entrapment

D.11.a.vi Opioids

Not Recommended – for acute, subacute, or chronic radial nerve entrapment pain

Recommended – for post-operative radial nerve pain management, for not more than one week

Rationale for Recommendations - There are no quality studies evaluating opioids for treating radial nerve entrapment. Opioids cause significant adverse effects – poor tolerance, constipation, drowsiness, clouded judgment, memory loss, and potential misuse or dependence have been reported in up to 35% of patients. Before prescribing opioids, patients should be informed of these potential adverse effects and cautioned against operating motor vehicles or machinery. Opioids do not appear to be more effective than safer analgesics for managing most musculoskeletal symptoms; they should only be used if needed for severe pain or for a short time (not more than one week) in the post-operative time. Opioids are not recommended for treatment of radial nerve entrapment, except as a brief post-operative course.

D.11.a.vii Vitamins

Not Recommended – vitamins, including pyridoxine, for acute, subacute, or chronic radial nerve entrapment

D.11.a.viii Lidocaine Patches

Not Recommended – for acute, subacute, or chronic radial nerve entrapment pain.

D.11.a.ix Ketamine

Not Recommended – for acute, subacute, or chronic radial nerve entrapment

D.11.b Treatments

D.11.b.i Rehabilitation: Therapy / Devices

Rehabilitation (supervised formal therapy) required as a result of a work-related injury should be focused on restoring functional ability required to meet the patient's daily and work activities and return to work; striving to restore the injured worker to pre-injury status in so far as is feasible.

Active therapy requires an internal effort by the patient to complete a specific exercise or task. Passive therapy are those interventions not requiring the exertion of effort on the part of the patient, but rather are dependent on modalities delivered by a therapist. Generally passive interventions are viewed as a means to facilitate progress in an active therapy program with concomitant attainment of objective functional gains. Active interventions should be emphasized over passive interventions.

The patient should be instructed to continue both active and passive therapies at home as an extension of the treatment process in order to maintain improvement levels.

Assistive devices may be included as an adjunctive measure incorporated into the rehabilitation plan to facilitate functional gains.

D.11.b.i.a Therapy (Active and Passive)

Physical or Occupational Therapy for Acute, Subacute, Chronic, or Post Operative Radial Nerve Entrapment

Recommended - for the treatment of acute, subacute, chronic, or post-operative Radial Nerve Entrapment.

Frequency/Dose/Duration –Total numbers of visits may be as few as two to three for patients with mild functional deficits or up to 12 to 15 with more severe deficits with documentation of ongoing objective functional improvement.

When there are ongoing functional deficits, more than 12 to 15 visits may be indicated if there is documentation of functional improvement towards specific objective functional goals (e.g., increased grip strength, key pinch strength, range of motion, advancing ability to perform work activities). As part of the rehabilitation plan a home exercise program should be developed and performed in conjunction with the therapy.

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

D.11.b.ii Magnets

Not Recommend – for acute, subacute, or chronic radial nerve entrapment.

D.11.b.iii Elbow and Wrist Splinting

Recommended – for acute, subacute, or chronic radial nerve entrapment.

Other

D.11.b.iv Accupuncture, Biofeedback, Manipulation and Mobilizaiton, Massage, Soft Tissue Massage, Iontophoresis, Phonophoresis

Not Recommended – Acute, subacute, or chronic radial nerve entrapment

D.11.b.v Low-Level Laser Therapy

Not Recommended – for acute, subacute, or chronic radial nerve entrapment

D.11.b.vi Ultrasound

Recommended – for acute, subacute, or chronic radial nerve entrapment

D.11.c Surgery

Radial Nerve Surgeries
Referral for surgery may be indicated for patients who have red flags of a serious nature (e.g., compressive neuropathy secondary to acute fracture), or have failed to respond to non-surgical management including wrist splints. Surgical considerations depend on the confirmed diagnosis of the presenting symptoms. If surgery is a consideration, counseling regarding likely outcomes, risks, and benefits, and especially expectations is important. It is also important to set pre-operative expectations that there is a necessity to adhere to the rehabilitative exercise regimen and work through post-operative pain. In the post-operative phase, range-of-motion exercises should involve the elbow, as well as the wrist and shoulder to avoid frozen shoulder ("adhesive capsulitis").

D.11.c.i Surgical Release for Treatment of Subacute or Chronic Radial Neuropathies

Recommended - for patients who fail non-operative treatment for subacute or chronic radial neuropathies or patients who have emergent or urgent indications (e.g., acute compression due to fracture, or compartment syndrome with unrelenting symptoms of nerve impairment).

Indications – Symptoms of radial neuropathy at the elbow, and a significant loss of function, as reflected in significant activity limitations due to the nerve entrapment and that the patient has failed non-operative care usually for at least three to six months. Patients should generally have failed wrist splints, avoidance of aggravating exposures, and full compliance in therapy. Patients with severe symptoms such as continuous tingling and numbness, progression of symptoms or functional impairment may be earlier surgical candidates. Many surgeons will not operate on a patient without a positive electrodiagnostic study. Ideally, the EDS should include inching technique. The type of surgical procedure selected is dependent on factors that include the preoperative electrodiagnostic studies, surgeon's comfort and experience and surgical anatomy.

D.12 Pronator Syndrome (Median Neuropathies in the Forearm)

Pronator syndrome involves median nerve entrapment under or within the pronator teres muscle in the proximal forearm. It causes pain in the flexor forearm and paresthesias similar to carpal tunnel syndrome, which is the main consideration in the differential diagnosis. Pronator syndrome is believed to cause nocturnal awakening less frequently than carpal tunnel syndrome. A confirmatory electrodiagnostic study is helpful and is recommended.

D.12.a Diagnostic Testing

D.12.a.i Pronator Syndrome Electrodiagnostic Study

Recommended – for confirmation of Pronator Syndrome

D.12.b Medications

For most patients, ibuprofen, naproxen, or other older generation NSAIDs are recommended as first-line medications. Acetaminophen (or the analog paracetamol) may be a reasonable alternative to NSAIDs for patients who are not candidates for NSAIDs, although most evidence suggests acetaminophen is modestly less effective. There is evidence that NSAIDs are as effective for relief of pain as opioids (including tramadol) and less impairing.

D.12.b.i Non-Steroidal Anti-inflammatory Drugs (NSAIDs) for Treatment of Acute, Subacute, Chronic, or Post-Operative Pronator Syndrome pain

Recommended - for treatment of acute, subacute, chronic, or post-operative Pronator Syndrome pain

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

Frequency/Duration – As needed use may be reasonable for many patients.

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

D.12.b.ii NSAIDs for Patients at High Risk of Gastrointestinal Bleeding.

Recommended – concomminent use of cytoprotective classes of drugs: misoprostol, sucralfate, histamine Type 2 receptor blockers, and proton pump inhibitors for patients at high risk of gastrointestinal bleeding.

*Indication*s – For patients with a high-risk factor profile who also have indications for NSAIDs, cytoprotective medications should be considered, particularly if longer term treatment is contemplated. At-risk patients include those with a history of prior gastrointestinal bleeding, elderly, diabetics, and cigarette smokers.

Frequency/Dose/Duration – Proton pump inhibitors, misoprostol, sucralfate, H2 blockers recommended. Dose and frequency per manufacturer. There is not generally believed to be substantial differences in efficacy for prevention of gastrointestinal bleeding.

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

D.12.b.iii NSAIDs for Patients at Risk for Cardiovascular Adverse Effects

Patients with known cardiovascular disease or multiple risk factors for cardiovascular disease should have the risks and benefits of NSAID therapy for pain discussed.

Recommended - Acetaminophen or aspirin as the first-line therapy appear to be the safest regarding cardiovascular adverse.

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

D.12.b.iv Acetaminophen for Treatment of Elbow Pain

Recommended - for treatment of elbow pain, particularly in patients with contraindications for NSAIDs.

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

Dose/Frequency – Per manufacturer's recommendations; may be utilized on an as-needed basis. There is evidence of hepatic toxicity when exceeding four gm/day.

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

D.12.b.v Opioids

<u>Not Recommended</u> – for acute, subacute, or chronic Pronator Syndrome pain

<u>Recommended</u> - for post-operative Pronator Syndrome pain management for not more than one week.

Rationale for Recommendations - There are no quality studies evaluating opioids for treating pronator syndrome. Opioids cause significant adverse effects – poor tolerance, constipation, drowsiness, clouded judgment, memory loss, and potential misuse or dependence have been reported in up to 35% of patients. Before prescribing opioids, patients should be informed of these potential adverse effects and cautioned against operating motor vehicles or machinery. Opioids do not appear to be more effective than safer analgesics for managing most musculoskeletal symptoms; they should only be used if needed for severe pain or for a short time (not more than one week) in the post-operative time. Opioids are not recommended for treatment of pronator syndrome, except as a brief post-operative course.

D.12.b.vi Glucocorticosteroids – Oral or Injections

<u>Not Recommended</u> – for acute, subacute, or chronic Pronator Syndrome

D.12.b.vii Vitamins

<u>Not Recommended</u> – vitamins, including pyridoxine, for acute, subacute, or chronic Pronator Syndrome

D.12.b.viii Lidocaine Patches

<u>Not Recommended</u> – for acute, subacute, or chronic Pronator Syndrome pain

D.12.b.ix Ketamine

<u>Not Recommended</u> – for acute, subacute, or chronic Pronator Syndrome

D.12.c Treatments

D.12.c.i Rehabilitation: Devices / Therapy

Devices

D.12.c.i.a Magnets

<u>Not Recommend</u> – for acute, subacute, or chronic Pronator Syndrome

D.12.c.i.b Elbow and Wrist Splinting

Recommended – for acute, subacute, or chronic Pronator Syndrome

Therapy (Active and Passive)

Rehabilitation (supervised formal therapy) required as a result of a work-related injury should be focused on restoring functional ability required to meet the patient's daily and work activities and return to work; striving to restore the injured worker to pre-injury status in so far as is feasible.

Active therapy requires an internal effort by the patient to complete a specific exercise or task. Passive therapy are those interventions not requiring the exertion of effort on the part of the patient, but rather are dependent on modalities delivered by a therapist. Generally passive interventions are viewed as a means to facilitate progress in an active therapy program with concomitant attainment of objective functional gains. Active interventions should be emphasized over passive interventions.

The patient should be instructed to continue both active and passive therapies at home as an extension of the treatment process in order to maintain improvement levels.

Assistive devices may be included as an adjunctive measure incorporated into the rehabilitation plan to facilitate functional gains.

D.12.c.i.c Therapeutic Exercise: Physical or Occupational Therapy for Acute, Subacute, Chronic, or Post Operative Pronator Syndrome

Recommended - for the treatment of acute, subacute, chronic, or post-operative Pronator Syndrome.

Frequency/Dose/Duration –Total numbers of visits may be as few as two to three for patients with mild functional deficits or up to 12 to 15 with more severe deficits with documentation of ongoing objective functional improvement.

When there are ongoing functional deficits, more than 12 to 15 visits may be indicated if there is documentation of functional improvement towards specific objective functional goals (e.g., increased grip strength, key pinch strength, range of motion, advancing ability to perform work activities). As part of the rehabilitation plan a home exercise program should be developed and performed in conjunction with the therapy.

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

Passive

D.12.c.i.d Low-Level Laser Therapy

Not Recommended – for acute, subacute, or chronic Pronator Syndrome

D.12.c.i.e Ultrasound

Recommended – for acute, subacute, or chronic Pronator Syndrome

Other

D.12.c.i.f Acupuncture, Biofeedback, Manipulation and Mobilization, Massage, Soft Tissue Massage, Iontophoresis, Phonophoresis

Not Recommended – Acute, subacute, or chronic Pronator Syndrome

D.12.d Surgery

Median Nerve Surgeries
Surgical release of the median nerve for pronator syndrome has been performed. Referral for surgery may be indicated for patients who have red flags of a serious nature (e.g., compressive neuropathy secondary to acute fracture), or have failed to respond to non-surgical management including wrist splints. Surgical considerations depend on the confirmed diagnosis of the presenting symptoms. If surgery is a consideration, counseling regarding likely outcomes, risks, and benefits, and especially expectations is important. It is also important to set pre-operative expectations that there is a necessity to adhere to the rehabilitative exercise regimen and work through post-operative pain. In the post-operative phase, range-of-motion exercises should involve the elbow, as well as the wrist and shoulder to avoid frozen shoulder ("adhesive capsulitis").

D.12.d.i. Surgical Release for Treatment of Subacute or Chronic Forearm Median Neuropathies, including Pronator Syndrome

Recommended - for patients who fail non-operative treatment for subacute or chronic median neuropathies in the forearm. It is also recommended for patients who have emergent or urgent indications (e.g., acute compression due to fracture, or compartment syndrome with unrelenting symptoms of nerve impairment).

Indications – Symptoms of median neuropathy in the forearm, and a significant loss of function, as reflected in significant activity limitations due to the nerve entrapment and that the patient has failed non-operative care usually for at least three to six months. Patients should generally have failed wrist splints, avoidance of aggravating exposures, and full compliance in therapy. Patients with severe symptoms such as continuous tingling and numbness, progression of symptoms or functional impairment may be earlier surgical candidates. Many surgeons will not operate on a patient without a positive electrodiagnostic study. Ideally, the EDS should include inching technique. The type of surgical procedure selected is dependent on factors that include the preoperative electrodiagnostic studies, surgeon's comfort and experience and surgical anatomy.

Rationale for Recommendation - If, after at least three to six months of conservative treatment, the patient fails to show signs of improvement, surgery may be a reasonable option if there is unequivocal evidence of median neuropathy that includes positive electrodiagnostic studies and objective evidence of loss of function as outlined above. Surgery is recommended for carefully selected patients.

Appendix One: Evidence of Use Tables

Evidence for the Use of NSAIDs for Lateral Epicondylalgia

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Labelle 1997 RCT	8.0	N = 128 with lateral epicondylitis (lateral elbow pain, pain on palpation of epicondyle or common extensor mass, pain with dynamic wrist pronation and dorsi-flexion against resistance with elbow extension, reproduce pain with static stretching of pronated wrist in palmar flexion with extended elbow and normal x-rays) 43% <6 weeks, 44% >6 months duration.	Diclofenac sodium SR 75mg BID vs. placebo for 28 days. Both groups cast immobilized for 14 days and were not to perform "repetitive movements" for 21 days.	Maximum pain-free grip strength improved by 5.9 kg after 28 days (p <0.001), but only trend towards significance between groups (7.2±9.8 vs. 4.6±10.1, p = 0.20). Diclofenac superior to placebo by VAS scale at 28 days (-29.9±26.3 vs. 16.0±27.4 mm, p <0.005). VAS function scale trended towards diclofenac (p = 0.10). No significant difference between groups for pain-free function index (p = 0.52). Ratio of maximum grip strength also favored diclofenac (p <0.05).	"Taking into account the limited improvement noted over rest and cast immobilization and the number of associated adverse events, it is difficult to recommend the use of diclofenac in the treatment of lateral epicondylitis at the dosage used in this study."	Detailed case definition; cast use unusual, but both groups so treated. Confounders addressed age, sex, weight, height, treatment, symptom duration, dominance, side affected, practice of racket sport, history of work-related accident, presence of other disease, or medication. High frequency of adverse events in diclofenac group (mostly abdominal pain/ diarrhea). Data suggest modest efficacy of NSAID.
Hay 1999 RCT	7.5	N = 164 with lateral epicondy-litis (pain and tenderness and pain on resisted isometric wrist extensor contract-ion). No treatment prior 12 months. Duration unclear, with approx 1/3 chronic.	Naproxen 500mg BID for 2 weeks vs. placebo (unmarked vitamin C) BID for 2 weeks) vs. methylpredni-solone 20mg plus 0.5mL 1% lignocaine injection 1cm distal to lateral epicondyle towards tender point; 12 months follow-up.	Percentages better (pain score ≤3) (4 weeks/6 months/12 months): injection (82/65/84) vs. naproxen (48/81/85) vs. placebo (50/83/82). Injection superior at 4 weeks (p <0.0001). Naproxen or placebo vs. injection slightly favored at 6/12 months.	"Early local corticosteroid injection is effective for lateral epicondylitis. Outcome at one year was good in all groups, and effective early treatment does not seem to influence this."	Confounders addressed age, gender, pain duration, social class, work status, general health, movement/ strength, and disability. Local skin atrophy at lateral epicondyle in 2 at 6 months, 1 at 12 months. Naproxen discontinued in 4 due to GI adverse effects. Data suggest comparable efficacy.

Lewis 2005 RCT Same study as Hay 1999 above	7.5	N = 164	Injection (20mg methylprednisolone plus 0.5mL 1% lignocaine) 1cm distal to epicondyle towards most tender point vs. naproxen (200mg BID) vs. placebo; 5-day duration of observation	Naproxen and injection groups both improved by Day 3 (p <0.01). Injection improved better than other 2 groups over 5 days, (p<0.05).	"Steroid injection was associated with an increase in reported pain for the first 24 hours of treatment, but the therapeutic benefits compared with naproxen and placebo were evident 3 to 4 days after the start of the treatment."	This report of above trial was for first 5 days compared with 1-year trial. Patients not blinded to treatment. Data suggest injection/ NSAID superior to placebo for ultra-short term follow-up.
Rosenthal 1984 RCT	4.5	N = 50 with humeroscapular periarthritis, acute lateral or medial epicondylitis (<10 days duration)	Flurbiprofen 100mg QID (could be decreased to 50mg QID after 1-2 weeks) vs. piroxicam 20mg BID (could be decreased to 20mg QD) for 4 weeks	Pain scores (Day 0/7/14/28): flurbiprofen (29.6/ 69.9/80.2/84.0) vs. piroxicam (27.4/ 63.8/68.7/72.1), p <0.05 at Day 14. Global Assessments (Days 7/14/28): flurbiprofen (2.4/ 3.9/5.2) vs. piroxicam (2.1/3.1/ 4.1), NS. Significant differences in favor of flurbiprofen for pain on passive movement Days 7, 14, and 28; pain on active movement Days 14 and 28, pain on pressure Day 28.	"Flurbiprofen was significantly superior to piroxicam with regard to relief of pain…[F]lurbiprofen showed greater improvements in all the other parameters throughout the study period."	Data suggest flurbiprofen superior to piroxicam for patients with acute humeroscapular periarthritis and epicondylitis.

Evidence for the Use of Topical NSAIDs and Other Agents for Lateral Epicondylalgia

There are 4 moderate-quality RCTs and randomized crossover trials incorporated in this analysis. There are 3 low quality RCTs(188, 190, 191) (Kroll 89; Burton 88; Liow 02) in Appendix 2.

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Spacca 2005 RCT	7.5	N = 158 with shoulder periarthritis or lateral epicondylitis (<5 days duration)	DHEP lecithin 1.3% gel vs. placebo TID for 10 days	VAS pain score day 3 reduced -20.1±20.2mm in DHEP lecithin gel vs. -9.9 ± 12.7mm placebo (p <0.001). Day 6 VAS pain score reduced -33.2 ±26.1 vs. -21.2±18.8mm with placebo (p <0.001). No statistically significant difference was found between 2 groups at end of the study.	"[T]he VAS score–as the primary criterion of efficacy–and the DASH questionnaire– as a secondary criterion–indicated that DHEP lecithin gel is an effective analgesic product for topical use in patients with shoulder periarthritis or lateral epicondylitis."	Trial of acute painful conditions. Data suggest short term efficacy of these rapidly resolving conditions. Differences disappeared by day 10, however most pain resolved by then.

Ritchie 1996 Crossover trial	4.5	N = 137 with multiple conditions (medial or lateral epicondylitis, supraspinatus tendinitis, bicipital tendinitis, subacromial bursitis or adhesive capsulitis). 53% shoulder vs. 47% elbow-related conditions.	Flurbiprofen local-action trans-cutaneous patch (40mg BID) vs. piroxicam gel (3cm, 0.5%, approximately 0.9g QID). Paracetamol (500mg) available as rescue medication.	Overall pain severity rated by unblinded investigator greater improvement on flurbiprofen (42%) vs. piroxicam (26%), p = 0.006). Improvement in overall severity of tenderness also favored flurbiprofen (26% vs. 16%, p = 0.03). At end of crossover phase 69% chose to continue with flurbiprofen LAT vs. 39% PG, p <0.001.	"Both treatments were well tolerated with a low incidence of mainly local adverse events. These results showed that flurbiprofen LAT had a greater efficacy than piroxicam gel, and was preferred by patients in the treatment of painful soft-tissue rheumatism of the shoulder and elbow."	Open label, no placebo. Mixed disorders and no stratification reported regarding potentially unequal results between more superficial vs. deep tissue disorders. Confounders addressed: patient groups balanced for gender, diagnosis, severity and duration of condition. Short duration of 4 days for each treatment followed by a choice treatment for 6 days, total 14 days. Limited results data suggest flurbiprofen superior to piroxicam.
Burnham 1998 Crossover trial	4.5	N = 14 with lateral epicondylitis of at least 2 months (mean 8.3 months)	2% diclofenac sodium in a pluronic lecithin liposome organo-gel (PLO) vs. placebo for 1 week duration	Graphic data presented. Average wrist extensor strength greater with diclofenac (p = 0.03). Pain less (p = 0.007) while using the diclofenac.	"Topical 2% diclofenac in PLO appears to provide effective short-term reduction in elbow pain and wrist extensor weakness associated with chronic lateral epicondylitis. Caution is still advised when patients with a history of peptic ulcer disease use topical diclofenac, particularly if the application area is broad."	Short term study with small sample size. None reported gastrointestinal symptoms while using diclofenac. One developed a rash at application site. Data suggest efficacy.
Schapira 1991 RCT	4.5	N = 32 with lateral epicondylitis of under 4 weeks duration	Diclofenac sodium gel vs. placebo QID for 2 weeks	Mostly graphic data presented. Percentage with moderate and severe pain or moderate incapacity (day 1/day 14): pain in AM diclofenac (75%/12.5%) vs. placebo (62.5%/37.5%). Functional incapacity: diclofenac (87.5%/31.25%) vs. placebo (87.5% vs. 56.25%). Reduced pain vs. placebo and improved pain-free range of motion and grip strengths with diclofenac.	"The results show a statistically significant gradually increasing clinical improvement in patients treated with diclofenac gel as compared with the control group, as well as a good tolerability of the drug in the treatment of soft-tissue rheumatism."	Short-term study (14 days duration). No adverse effects observed except for a solitary transient, mild, and localized skin rash that did not necessitate discontinuation of the drug. B coefficients increased consistently from day 4-14, which may indicate cumulative effect of drug. Data suggest efficacy.

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

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Struijs 2004 RCT	7.0	N = 180 with lateral epicondylitis (lateral elbow pain, aggravated with both epicondylar pressure and resisted wrist dorsiflexion) for at least 6 weeks	Brace-only (Velcro strap, Epipoint, day use continuously) vs. physical therapy (9 sessions: 7.5 min, ultrasound, friction massage 5-10 min., progressive exercise program, HEP 2x/day) vs. brace plus PT 6 weeks; 26 wks follow-up.	No differences in success between groups. Mean±SD patient satisfaction comparing group A (PT) vs. group B (Brace) vs. group C (Combination): After 6 weeks: 75±20 vs. 66±26 vs. 77±19; p (A-B) <0.05; P (B-C) <0.05. Pressure pain after 6 weeks: 17±37 vs. 22±33 vs. 30±30; p (A-C) <0.05.	"Conflicting results were found. Brace treatment might be useful as initial therapy. Combination therapy has no additional advantage compared to physical therapy but is superior to brace only for the short term."	Multiple co-interventions in physical therapy. No differences over 6 months to a year. Data suggest minimal short term benefit of physical therapy at 6 weeks.
Struijs 2006 RCT	7.0	N= 180 with tennis elbow	Brace (n=68) vs. physiotherapy (n=56) vs. combination of the two (n=56) with follow-ups at 6/26/52 weeks.	Success rates were 89% (47) for physiotherapy, 86% (54) for brace, and 87% (47) for combination.	"No clinically relevant or statistically significant differences in costs were identified between three strategies."	Cost effectiveness study. Follow-up of 2004 study.
Öken 2008 RCT	5.5	N = 58 with lateral epicondylitis (lateral elbow pain, tenderness, pain on resisted wrist extension); duration at least 1 month (mean 3.5-6.2).	Brace (Ortho-care 3125) during day for 2 weeks vs. ultrasound (1MHz, 1.5W/ cm2 for 5 minutes, 5 days a week for 2 weeks) vs. low level laser therapy (He-Ne, 632.8nm, 10mV). All performed HEP (stretching/ strengthening); 6 weeks follow-up	VAS pain (pre/Week 2/Week 6): brace (8.1±1.3/4.8±2.6/6.7±0.9) vs. US (7.8±1.5/ 6.4±3.1/5.7±2.2) vs. laser (7.1±1.4/4.4± 2.2/4.3±1.2), p = 0.097, 0.189, 0.067. Grip strengths: brace (43.7/46.3/36.2) vs. US (45.1/44.4/43.6) vs. laser (45.8/54.8/ 56.3) (all NS).	"[A] brace has a shorter beneficial effect than US and laser therapy in reducing pain, and that laser therapy is more effective than the brace and US treatment in improving grip strength."	All received exercises. Co-interventions not controlled. Some trends in baseline differences with lower pain in laser group and longer duration (3.5 vs. 4.3 vs. 6.2 months). Grip strengths do not appear entirely consistent/logical if significant pain. No placebo or non-interventional control.

van de Streek 2004 RCT	4.5	N = 43 with tennis elbow; duration at least 3 weeks	Elbow band (Thämert Epi-med, Group I, n = 20) vs. forearm/ hand splint (Thämert Epi-med elbow band, orthoflex brace and aluminum bar from elbow to palm, Group II, n = 23) for 6 weeks	Sum score overall PRFEQ (pre/post): Group 1 (82.5±22.0/ 56.6±24.0) vs. Group 2 (77.5±26.3/58.3± 35.1). No differences in Maximum grip strengths, sum pain score, function scores.	"[T]he forearm/hand splint is not more effective than the elbow band as a treatment for lateral epicondylitis."	Some baseline differences that may bias against splint (prior treatment 39% vs. 5%). Splint noted to have interfered with work for some. Data suggest no differences between elbow band and forearm brace.
Faes 2006 Randomized crossover trial	4.5	N = 63 with lateral epicondylitis ages 18-70, with persistent symptoms despite alternative treatments; durations median 4, 5.5 months (minimum 2 months)	Dynamic extensor brace (Group 1, n = 30) vs. no brace (Group 2, n = 33) for 12 weeks each; 24 weeks follow-up	Brace first group improved more rapidly than no-brace group all outcome measures in first 12 week period, p <0.042. When crossover, braced first group sustained treatment effect. At 24 weeks, no differences between groups of brace wearers for any outcome measures.	"The dynamic extensor brace is an effective therapeutic tool for treating lateral epicondylitis."	Brace is on the wrist to off-load the elbow. May interfere with work. Data suggest efficacy.
Haker 1993 RCT	4.0	N = 61 with lateral elbow pain and 2+ of: tenderness over lateral epicondyle, resisted wrist extension, passive extensor stretching, resisted finger extension; duration at least 1 month	Elbow band (Epicondylitis-Clasp, Group I, n = 11) vs. splint (forearm support with wrist in 30º dorsiflexion, Group II, n = 19) vs. injection (triamcinolone 0.2mL of 10mg/mL plus bupivacaine HCl 0.3ml into maximal tenderness; 2nd injection in 1 week if no effect, Group III, n = 19); 3 months brace/splint use; 1 year follow-up.	Percent excellent or good outcomes (2 weeks/3 months/6 months/12 months): Group 1 (11/50/44/38) vs. Group II (5/21/53/42) vs. Group III (68/63/28/31). Steroid superior at 2 weeks (p <0.001), and NS other times. Vigorimeter test different between group I (2) and group III (28) at 2 weeks, p< 0.05, and between group II (3) and group III (28), p <0.05.	"[D]espite the high incidence of recurrence and the clinical side-effects reported after local steroid injection… steroid injection might be the treatment of choice in very severe cases to achieve rapid relief of pain."	Data suggest injection superior in short term. Trend towards worse results in injection at 6-12 months.

Evidence for Exercise Programs for Lateral Epicondylalgia

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Exercise vs. No Exercise						
Bisset 2006, 2009 RCT	7.0	N = 198 with tennis elbow, at least 6 weeks duration	Wait and see vs. injection (triamcinolone acetonide 20mg plus 1mL 1% lidocaine) vs. physiotherapy (elbow manipulation and therapeutic exercise, 8 treatments of 30 minutes plus HEP including resistant band over 6 weeks). All received information booklet and "practical advice."	For pain-free grip ratio: at 3/6 weeks injection (compared to wait and see) favorable with 42.0 (32.6 to 51.3)/36.4 (26.5 to 46.3), mean (95% CI). At 26/52 weeks wait and see favorable with -19.6 (-33.0 to -6.2)/ -12.1 (-23.6 to 0.3). At 6 weeks physiotherapy favorable over wait and see 20.1 (10.3 to 30.0), at 52 weeks less favorable at 4.3 (-7.5 to 16.2). Injection favored over physiotherapy at 3/6 weeks with 31.2 (22.2 to 40.2)/16.3 (6.6 to 26.0), at 26/52 weeks physiotherapy favorable with -30.1 (-43.1 to -17.2)/-16.4 (-27.9 to -4.8). For Assessor severity rating: at 3/6 weeks injection favorable over wait and see at 35.9 (28.3 to 43.4)/ 29.9 (22.2 to 37.7), at 26/52 weeks wait and see favorable -17.5 (-26.2 to -8.9)/-8.3 (-15.2 to -1.3). Physiotherapy overall favorable over wait and see at 3/52 weeks 9.8 (2.3 to 17.3)/5.1 (-1.9 to 15.2). Injection at 3/6 weeks favorable over physiotherapy 26.1 (18.7 to 33.4)/15.0 (7.2 to 22.6), at 26/52 weeks physiotherapy favorable -25.7 (-34.4 to -17.1)/ -13.3 (-20.4 to -6.3).	"Physiotherapy combining elbow manipulation and exercise has a superior benefit to wait and see in the first six weeks and to corticosteroid injections after six weeks, providing a reasonable alternative to injections in the mid to long term. The significant short term benefits of corticosteroid injection are paradoxically reversed after six weeks, with high recurrence rates, implying that this treatment should be used with caution in the management of tennis elbow."	Confounders addressed include removal of those participants who did not adhere to the protocol, assessment of non-protocol treatment, blinding (had assessor guess at end of study and conducted post-hoc analyses). Data suggest injections most successful short-term. Wait and see and physiotherapy equivalent at 1 year.
Tonks 2007 RCT	4.0	N = 48 with diagnosis of tennis elbow (pain on palpation and resisted	No treatment vs injection only (triamcinolone 10mg plus 2% lignocaine, total 1mL to symptomatically tender area) vs	Patient Related Forearm Evaluation Questionnaire (PRFEQ) superior in injection group for pain (-2.88±1.80 vs. PT -0.70±1.85 vs. combined -3.31±2.81	"Injections alone are effective not only in terms of their pain relieving and function improving effect, but are much more time and cost efficient than	Relatively small sample sizes to detect benefits between groups. Data suggest injections effective, but

		wrist extension). Duration unclear.	physiotherapy only (Pienimaki Physiotherapy 1996), stretching and conditioning) vs combined. 7 weeks follow-up.	vs. observation 0.34±1.43), p = 0.001), PRFEQ function (p = 0.001), and overall (p = 0.001). Pain Free Grip Strengths changes from baseline (10.14±8.64 vs. 4.96 ±12.22 vs. 8.76±6.13 vs. 1.47±7.7), NS.	physiotherapy."	trends appear in data in favor of exercise over observation.
Immediate vs. Delayed Therapy						
Park 2010 RCT	4.5	N=31 patients with lateral epicondylitis with persistent symptoms for at least 6 weeks	Immediate physical therapy (group I) (n=16) vs. delayed physical therapy after 4 weeks of NSAIDs (group D) (n=15).	Mean±SD VAS scores comparing Group I vs. Group D at 1month: 29.7±11.8 vs. 49.4±13.9; p<0.01. No differences were found at months 3 and 6.	"[I]sometric exercise reduces pain and improves elbow function within a short period. After three-months of follow-up, except for a difference in compliance at three months, there were no differences in the other variables."	Immediate vs. delayed PT biases in favor of immediate as equivalent to wait-listed controls. Compliance good only in immediate treatment groups. No differences at 3 months. Suggests no need to rush therapy.
Comparing Types of Exercise						
Martinez-Silvestrini 2005 RCT	4.0	N = 94 patients with chronic (>3 months) lateral elbow pain; maximal tenderness at lateral epicondyle and pain with 2 of: resisted wrist exten-sion, resisted middle finger extension, and/or chair lift test.	Stretching (wrist extensors x 30s, 3 reps TID) and other conservative therapy (strap, education, avoid exacerbating activities, ice massage TID) vs. stretching plus concentric strengthening (progressive, purely concentric, resistance bands) vs. stretching plus eccentric strengthening (progressive, purely eccentric, resistance bands). All in HEP; 6 weeks treatment.	Mean±SD VAS score (baseline/6 weeks) comparing stretching vs. concentric vs. eccentric: 48±21/25±24 vs. 49±21/35±25 vs. 46±20/24±24; p = 0.33 between groups. Also no differences in pain-free grip, Patient-rated Forearm Evaluation Questionnaire and DASH function.	"Although there were no significant differences in outcome among the groups, eccentric strengthening did not cause subjects to worsen. Further studies are needed to assess the unique effects of a more intense or longer eccentric strengthening program for patients with lateral epicondylitis."	No control for multiple co-interventions. Data suggest no meaningful differences in outcomes.
Exercise vs. Other Treatments						
Coombes 2013 RCT	8.0	N = 165 with unilateral lat. epicondylalgia of at least 6 weeks duration.	Saline injection vs. corticosteroid injection to greatest tender point (triamcinolone 10mg plus 1mL 1% lignocaine) vs. physiotherapy (PT) plus saline injection	Glucocorticosteroid injections superior at 4 weeks (worse pain, resting pain, pain and disability and quality of life). At 1 year, corticosteroid injections associated with less complete	"Among patients with chronic unilateral lateral epicondylalgia, the use of corticosteroid injection vs. placebo injection resulted in worse clinical outcomes after 1	Mostly chronic LE (>6weeks). Blinding to injection type, not PT. Less resting pain in corticosteroid injection only group at

		No recent injections.	vs. PT plus corticosteroid injection. PT [8x30-minute sessions plus HEP (2 times aday). Manipulation, concentric/eccentric, gripping, latex band exercises.] Follow-ups at 4, 8, 12, 26, and 52 weeks.	recovery or much improvement (68/82 (83%) vs. 7881 (96%), RR = 0.86, NNT = -7.5, p = 0.01). Greater recurrences (54% vs. 12%, NNT = -2.4, p<0.001). No differences between PT and no PT at 1year with 91% vs. 88%, p = 0.25 complete recovery or much improvement.	year, and physiotherapy did not result in any significant difference."	baseline. Uncontrolled NSAID use. PT individualized, precluding detailed assessments; 71-73% of patients guessed the injection type correctly, suggesting some unblinding. Data suggest short term efficacy of injection, but long-term worse results and no efficacy of PT.
Pienimäki 1996 RCT	5.0	N = 39 with chronic lateral epi-condylitis (required positive Mill's test and resisted wrist and/or middle finger extension plus local tenderness) most symptoms >3months.	Exercise (PT appt QO week with stepped slow repeated wrist and forearm stretches, muscle conditioning, occupational exercises. HEP 4-6 times a day) vs. ultrasound (0.3-0.7 W/cm^2, 10-15minute session, 2-3 times a week) for 6 to 8 weeks treatment. 8 weeks follow-up.	VAS pain at rest changes: Exercise - 1.9±1.8 vs. US +0.2±2.6, p=0.004. Pain under strain (p = 0.04), Working inability (p = 0.004), sleep disturbance (p = 0.01) all favored exercise. Isokinetic torque favored exercise group (p = 0.0002). No difference between groups for grip strength, manual provocative test. 6/8 (75%) of exercise group vs. 3/9(33%) of US group became able to work.	"[P]rogressive strengthening and stretching exercise treatment is more effective than pulsed ultrasound in treating chronic lateral epicondylitis: it reduced chronic pain and improved upper limb function and the ability to work of patients in the study. It may correct the ill-effects of prolonged immobilisation, counter patients' fear of using the forearm and hands, and help them to return to work."	Some details sparse. Data suggest exercise superior to US for chronic lateral epicondylitis. Outcomes data included return to work which differed between the 2 groups (75% vs. 33%).
Pienimäki 1998 RCT Follow-up report of above study	4.0	N = 39 with chronic lateral epicondylitis	Exercise vs. ultrasound as above. Mean 36 months follow-up.	Sixty-seven percent of the exercise group vs. 45% of ultrasound were in previous job. Absent work in 33% exercise vs. 55% ultrasound; 0% exercise retired vs. 18% ultrasound (though noted to be other than epicondylitis-related). Surgeries in 6% exercise vs. 36% ultrasound.	"The progressive exercise evaluated in this study showed beneficial long-term effects compared to ultrasound treatment in terms of pain alleviation and working ability… Exercise may be able to prevent chronicity and should hence be tried and recommended."	Some details sparse. 23/39 followed. Data suggest exercise superior to US for longer term results, however dropout rate considerable, somewhat limited strength of conclusions.
Exercise as Co-Intervention						
Newcomer 2001 RCT	9.5	N = 39 with lateral epicondylitis (lateral elbow tender-ness	Rehabilitation program in both arms (ice massage TID 5 times a day; wrist stretching,	Mean decrease in pain with grasp (baseline-4 weeks/8 weeks/6 months): injection (0.79/0.82/1.85) vs. placebo	"A corticosteroid injection does not provide a clinically significant improvement in the outcome of LE, and	Injections combined with "rehabilitation program," thus multiple co-interventions.

		or extensor mass tender-ness plus pain with resisted finger or wrist extensor testing) of under 4 weeks duration	concentric/eccentric strengthening of wrist extensors and flexors, 3 sets of 10 reps presumably daily) plus betamethasone 6mg plus 4mL 0.25% bupivacaine hydrochloride vs. 5mL bupivacaine. Injections given to most tender point, hit bone, withdrawn slightly and then injected; 6 months follow-up.	(0.56/1.12/1.56) (NS). Multiple other outcomes measures also NS, with sole exception of VAS pain scale between 8weeks and 6mo favoring steroid injection (p <0.05).	rehabilitation should be the first line of treatment in patients with a short duration of symptoms."	Rehabilitation program compliance not assessed. Scored high quality for double-blinding with steroid vs. placebo. Confounders addressed age, gender, symptom duration. Data suggest injection not of significant additive benefit. Conclusion that rehabilitation should be 1st line treatment not supportable with data from this study as both received same treatment.
Struijs 2004 RCT	7.0	N = 180 with lateral epicondylitis (lateral elbow pain, aggravated with both epicondylar pressure and resisted wrist dorsi-flexion) for at least 6 weeks.	Brace-only treatment (Velcro strap, Epipoint, daytime use continuously) vs. physical therapy (9 total sessions: 7.5min ultrasound (Binder BMJ 85), friction massage 5-10min, progressive exercise program, HEP 2 times a day) vs. brace plus physical therapy for 6 weeks. 26 weeks follow-up.	No differences in success between groups. Mean±SD patient satisfaction comparing group A (PT) vs. group B (Brace) vs. group C (Combination): After 6 weeks: 75±20 vs. 66±26 vs. 77±19; p (A-B) <0.05; P (B-C) <0.05. Pressure pain after 6 weeks: 17±37 vs. 22±33 vs. 30±30; p (A-C) <0.05.	"Conflicting results were found. Brace treatment might be useful as initial therapy. Combination therapy has no additional advantage compared to physical therapy but is superior to brace only for the short term."	Multiple co-interventions in physical therapy. No differences over 6 months-1 year. Data suggest minimal short term benefit of physical therapy at 6 weeks.
Smidt 2002 RCT	6.5	N = 185 with lateral epicondyl-itis (pain in lateral elbow, increased pain with epicondylar pressure and resisted wrist dorsi-flexion) Subacute and chronic pain	Wait and see (avoid provocative activities, ergonomic advice, paracetamol) vs. injection (1mL triamcinolone acetonide (10mg/mL) and 1mL lidocaine 2%; up to 3 injections) vs. physiotherapy (9 sessions of pulsed ultrasound, 2 W/cm^2 for 7.5minutes per session; deep friction massage, exercise	Main complaint improvement (3/6/12/26/52 weeks): wait and see (6±14/21±32/33±30/47±30/53±28) vs. injection (43±28/46±30/37±30/36±34/44±32) vs. physiotherapy (11±18/26±28/43±31/53±31/59±25). At 6/52 weeks success rates for injections were 92%/ 69%, physiotherapy 47%/91%, and wait and see 32%/83% (all NS).	"The decision to treat with physiotherapy or to adopt a wait-and-see policy might depend on available resources, since the relative gain of physiotherapy is small."	Large sample size. Physiotherapy group with mixed interventions. Confounders addressed age, gender, duration of current episode, dominant elbow affected, acute onset, concomitant neck disorders, previous episodes of lateral elbow

			program); 52 weeks follow-up			pain, putative cause, and use of analgesics during past week. Data suggest wait and see not different from physiotherapy, but trends towards physiotherapy. Data suggest injections superior in short term, then trends to be inferior.
Langen-Pieters 2003 RCT	4.0	N = 13 with lateral epicondy-litis, criteria not described; mostly chronic and subacute	Chiropractic care [manipulation of elbow (posterior to anterior glide of radial head in pronation, medial to lateral and lateral to medial glide of humeroulnar and humeroradial joint and long-axis distraction of elbow), stretching, strengthening exercises] vs. ultrasound (3MHz, 1.5W/cm^2 for 5 minutes). Average 2 treatments a week for 6 weeks; 6 weeks follow-up.	VAS pain scales (pre/3 weeks/post): chiropractic care (5.2±2.3/2.7±1.5/2.3±1 .5) vs. US (3.5±1.0/2.6±1.5/0.7±0 .6; p = 0.25, 0.72, 0.03). Pain free function (p = 0.041) also favored US.	"Continuous ultrasound is more effective than chiropractic care in reducing pain and improving PFF (pain free function) in lateral epicondylitis, but that chiropractic care is equally effective in improving grip strength. Combined therapy approach would be of most benefit."	Pilot study; short-term follow up; small sample size; low power; no placebo control. Manipulation combined with stretching and strengthening precludes assessing effect of manipulation alone; 1 "complete recovery." Conclusion that combined therapy approach most beneficial not supportable by evidence. Data suggest ultrasound superior.

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

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Ice Plus Exercise vs. Exercise						
Manias 2006 Pseudo-randomized pilot trial	4.0	N = 40 patients over 18 years with lateral elbow pain and clinically diagnosed with lateral elbow tendinopathy (lateral elbow pain, less pain with resisted supination at 90°	Exercise programme (slow progressive eccentric exercises of wrist extensors and static stretching exercises of ECRB tendon, 3 sets of 10 reps) plus ice after exercise programme for 10 minutes (n = 20) vs. exercise	Pain over prior 24 hours (baseline/4 weeks/16 weeks): exercise plus ice (8.60/1.70/1.50) vs. exercise alone (8.80/1.90/1.60), NS. No differences between groups for changes in	"An exercise programme consisting of eccentric and static stretching exercises had reduced the pain in patients with LET at the end of the treatment and at	Pseudo-randomized as every other allocation. Study did not assess ice alone. Ice did not appear effective as

		flexion rather than extension, and pain in at least 2 of Tomsen, resisted MF, Mill's and handgrip dynamometer tests). Duration at least 4 weeks.	program alone (n = 20) for 4 weeks; 3 months follow-up.	pain.	the follow up whether or not ice was included."	additive treatment.

Evidence for the Use of Iontophoresis for Lateral Epicondylalgia

There are 6 moderate-quality RCTs incorporated into this analysis.

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Iontophoresis with Glucocorticosteroid vs. Placebo						
Nirschl 2003 RCT	7.5	N = 199 with medial or lateral epicondylitis under 3 months duration; diagnostic criteria not described.	Iontophoresis with 2.5 ml dexamethasone sodium phosphate 0.4% injection vs. 2.5 ml saline solution. Both treatments at 40 mA-minutes, 6 treatments over 15 days; 1-month follow-up.	Dexamethasone favored over placebo VAS pain improvement at 1 month (23 vs. 14, p = 0.012) and percentage global evaluation by investigator moderate or better (52 vs. 33, p = 0.013). Investigators' pain evaluation score (p = 0.019) and investigators' tenderness score (p <0.001) also favored iontophoresis with dexamethasone. Number of patients with improvement in all 3 primary efficacy variables significantly favored dexamethasone (p = 0.039).	"Iontophoresis treatment was well tolerated by most patients and was effective in reducing symptoms of epicondylitis at short-term follow-up."	Confounders addressed: gender, age, symptom duration, prior treatments, and prior medications. Unknown how many patients had medial epicondylitis, but assume relatively few and no stratified analyses. Free to use other treatment modalities after 2-day follow-up visit. Patients who completed all 6 treatments in 10 days or less showed better results than those completing over longer period. Data suggest modest efficacy of iontophoresis with dexamethasone.
Vecchini 1984 RCT	6.0	N =24 with untreated scapula-humeral periarthritis (12) or elbow epicondylitis (12). Duration unclear, but likely mostly acute pain patients.	Ionization with diclofenac vs. saline; 20 daily treatments. No follow-up beyond day 20.	Pain at rest moderate plus severe (pre/post): diclofenac 8/10 (80%)/0/10(0%) vs. placebo 8/13 (61.5%)/7/13 (53.8%). Good or excellent overall physician judgment of results in diclofenac 9/10 (90%) vs. placebo 2/13 (15.4%).	"The results of this study demonstrate that the ionization procedure per se had a moderate therapeutic effect in our patients with epicondylitis and scapulo-humeral periarthritis particularly with regard to pain on movement and functional impairment."	Sparse details. Results suggest diclofenac efficacious. Intensive treatment regimen of 20 daily sessions.
Baskurt	6.0	N = 61 with	Naproxen gel	VAS pain scores (pre/	"Results suggest	Multiple co-

2003 RCT		lateral epicondylitis (diagnostic criteria and duration not stated)	(10%) by phonophoresis given through Pagani Ultrasound (1mHz, 1W/cm2) vs. naproxen gel (10%) given via Pagani Galvanic (0.08-0.004mA/cm^2). Both groups treated with cold, strengthening and stretching exercises. Average approximately 20 sessions each group. Average duration of follow-up 4.5±1.8 months.	post): phonophoresis (3.62±2.73/1.12± 1.18) vs. iontophoresis (3.15±2.45/0.72± 1.85). Grip strength measures also improved, but no differences between groups. Pain severity decreased/grip strength increased, neither statistically significant when compared with pretreatment (p >0.05). Nirshl-Petterone Scoring System scores compared before and after also not significant (p >0.05).	that iontophoresis and phonophoresis of naproxen are equally effective electrotherapy methods in the treatment of lateral epicondylitis."	interventions. Many treatment sessions applied and varied considerably weaken conclusions considerably. Confounders addressed: age, gender and occupation. No placebo group and natural history is improvement, thus possible interpretation is also that both treatments are equally ineffective.
Saggini 1996 RCT	4.5	N = 60 with various conditions (12 epicondylitis, 30 scapulo-humeral periarthritis, 10 gonalgia, 8 metatarsalgia)	Iontophoresis with 30mg of ketorolac in 5mL of distilled water vs. placebo QOD for 20 minutes for 5 treatments	VAS pain scale (pre/ post/7 days): ketorolac (6.55±2.14/ 4.22±2.51/2.74±2.53) vs. placebo (5.89± 2.33/3.88±2.12/4.12± 2.45). More had no improvement with placebo (p <0.04) and intermediate results (p <0.02) vs. ketorolac while more good results with ketorolac (p <0.007).	"This study demonstrates that ketorolac relieves pain when delivered by EMDA and offers longer-lasting pain relief than does placebo."	Study included many disorders and no stratified results. Randomization was only briefly discussed and there were limited statistics to compare treatment and placebo group. Results suggest ketorolac by iontophoresis superior to placebo.
Runeson 2002 RCT	4.5	N = 64 with lateral epicondylalgia (pain on palpation of lateral epicondyle, resisted wrist extension, middle-finger test and vigorimeter test). Pain of at least 1 month, mostly chronic.	Iontophoresis with 0.4% dexamethasone sodium phosphate vs. placebo. 4 treatments over 2 weeks; 6 months follow-up.	No difference between 4 tests after 4 treatments. Both groups improved and most patients reported "completely recovered" [placebo 14/21 (66.7%) vs. dexamethasone sodium phosphate 12/20 (60%) NS].	"[N]o significant difference concerning the pain-relieving effect could be observed between the corticosteroid group and the placebo group. However, an identical improvement was observed in both groups throughout the study."	High rate of changing to other treatments at 3 months 35.9% (23/64). Confounders addressed age, sex, affected arm, duration of pain, cause of pain, and previous treatment. Male dominance in group that completed study. Data suggest iontophoresis with dexamethasone not efficacious.
Iontophoresis vs. Other Active Treatment						

Demirtas 1998 RCT	5.5	N = 40 with subacute and chronic lateral epicondylitis	Infrared treatment (250W, 20 minutes) after either iontophoresis 6-11mA (individual tolerance) with sodium diclofenac vs. sodium salicylate 2%. Daily treatments, 5 days a week, up to 18 days. Seven days follow-up.	Pain scores after treatment were 0/3 score for diclofenac (18/20, 90%) vs. salicylate (11/20, 55%), p <0.05. Significant reductions in pain for both groups for many measures (e.g., pain scores produced by pressure) resisted wrist extension, function, and spontaneous pain at rest). Sodium diclofenac had less pain produced by lateral epicondylar pressure (p <0.05) and pain on resisted wrist extension (p <0.01).	"The results suggest some benefits from the process of iontophoresis and the use of infrared in the treatment of lateral epicondylitis and indicate that iontophoresis of sodium diclofenac is more effective than that of sodium salicylate."	No placebo group. Both groups received IR, precluding assessment of value of IR. Short-term follow-up only. Intensive treatment regimen. Data suggest iontophoresis with diclofenac superior to sodium salicylate.

Evidence for the Use of Ultrasound for Lateral Epicondylalgia

There are 2 high- and 10 moderate-quality RCTs incorporated into this analysis. There are 2 low-quality RCTs(219, 244) in Appendix 2.

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Ultrasound vs. Sham						
Haker 1991 RCT	8.5	N = 45 with lateral epicondylalgia (lateral elbow pain, tenderness on palpation and resisted wrist extension with elbow extended) of at least 1 month duration (mostly chronic)	Pulsed ultrasound (1MHz, 1:4, 1W/cm^2) vs. sham. Each session 10 minutes, 2-3 times a week; 10 total treatments; 12 months follow-up.	There were no significant differences in relation to subjective or objective outcomes between the groups after the treatment period or at the follow-ups. No differences in vigorimeter at any follow-up.	"Our results do not support the use of pulsed ultrasound treatment with the chosen parameters in lateral epicondylalgia."	Some results sparse. Confounders addressed profession, pain onset, pain at night and at rest, pain character, time of sick listing, work-load, involvement in monotonous and repetitive movements, activities worsening pain, affected arm, cause, previous treatment. Data suggest US not effective.
D'Vaz 2006 RCT	8.0	N = 55 with lateral epicondy-litis at least 6 weeks duration	Pulsed ultrasound (30mW/cm^2) vs. sham. Daily self-administered treatment, 20 minutes a day for 12 weeks.	At least 50% improvement in VAS score among 64% US vs. 57% sham (NS). Pain scores not different (no significant statistical differences were found at anytime between the groups) 95% CI.	"In this study LIUS was no more effective for a large treatment effect than placebo for recalcitrant LE. This is in keeping with other interventional studies for the	Selection bias. Confounders addressed gender, age, arm affected, time since onset of current episode, previous management. Highly intensive, daily treatment though with pulsed

					condition."	low-intensity US, which did not appear effective.
Lundeberg 1988 RCT	5.5	N = 99 with epicondy-lalgia	Ultrasound (1.0MHz, 1.0W/cm^2) plus rest vs. Sham ultrasound plus rest vs. Rest only; 10 treatments, 2 times a week over 5 to 6 weeks.	Mean VAS improvement after 3 months was US 2.8 ±0.3 vs. Sham 2.4±0.3 vs. rest 2.1±0.5. Mean improvement after 3 months on grip strength in extension US 39.4± 3.8 vs. sham 40.2±3.1 vs. rest 36.2±4.3. NS between US and sham. US superior to rest (p <0.01).	"A significant improvement was noted when the effect of continuous ultrasound was compared with rest, but continuous ultrasound treatment was not significantly better than placebo ultrasound."	Some details sparse. Confounders addressed symptom duration on entry, dominance of affected arm, and treatment given before referral. Data suggest US plus rest or rest ineffective.
Binder 1985 RCT	5.0	N = 76 with lateral epicondy-litis	Pulsed ultrasound (1.0MHz, 1-2W/cm^2) vs. placebo; 5-10 minutes sessions, 12 sessions over 4 to 6 weeks; 8 weeks follow-up.	Satisfactory outcomes among 63% US vs. 29% sham, p <0.01. Ultrasound superior for pain on wrist dorsiflexion, pain with weight test, pain score, grip strength (in flexion) and grip strength (in extension) at 8 weeks (all p <0.005).	"[U]ltrasound enhances recovery in patients with lateral epicondylitis but in only 63% of cases. By serial assessment of clinical variables we were able to confirm that the rate of recovery was significantly better in treated patients than the placebo group, and later review suggested a lower incidence of recurrence in the patients who responded to ultrasound."	Confounders addressed: age, gender, duration of symptoms at presentation, dominance of affected arm, treatment given before referral. Data suggest US superior to sham.
Ultrasound vs. Other Active Treatment						
Klaiman 1998 RCT	6.5	N = 49 with epicondylitis, tendinitis (bicipital, supra-spinatus, Achilles, Patellar), tenosynovitis (de Quervains), plantar fasciitis	Phonophoresis (gel containing 0.05% fluocinonide used as coupling agent) vs. Ultrasound (identical gel absent steroid), 1.5W/cm^2, 8min/session, 3 times a week for 3 weeks. 3 weeks follow-up.	Both groups improved after 3 weeks (p <0.05). No differences between groups (VAS: US 5.5-1.9, PH 5.0-2.0; algometry (involved limb): US 4.7 lb-7.1 lb, PH 5.1 lb-6.6 lb).	"US results in decreased pain and increased pressure tolerance in these selected soft tissue injuries. The addition of PH with fluocinonide does not augment the benefits of US used alone."	Mixed disorders. Breakdown of results by individual conditions not provided, though underpowered. Short-term follow-up. No placebo control. Without placebo/sham, both treatments equally effective or ineffective.
Öken 2008 RCT	5.5	N = 58 with lateral epicondylitis (lateral elbow pain, tenderness, pain on resisted	Brace (Orthocare 3125) during daytime for 2 weeks vs. ultrasound (1MHz, 1.5W/cm2 for 5 minutes, 5 day/week for 2	VAS pain (pre/Week 2/ Week 6): brace (8.1±1.3/ 4.8±2.6/6.7±0.9) vs. US (7.8±1.5/6.4±3.1/5.7±2.2) vs. laser (7.1±1.4/4.4±2.2/	"[A] brace has a shorter beneficial effect than US and laser therapy in reducing pain, and that laser therapy is more effective than the brace	All received exercises. Co-interventions not controlled. Some trends in baseline differences with lower pain in laser group and longer

		wrist extension). Duration at least 1month (means 3.5-6.2)	weeks) vs. low level laser therapy (He-Ne, 632.8nm, 10mV). All performed HEP (stretching and strengthening). 6 weeks follow-up.	4.3±1.2), p = 0.097, 0.189, 0.067. Grip strengths: brace (43.7/46.3/36.2) vs. US (45.1/44.4/43.6) vs. laser (45.8/54.8/56.3) (all NS).	and US treatment in improving grip strength."	duration (3.5 vs. 4.3 vs. 6.2 months). Grip strengths do not appear consistent/ logical if significant pain. No placebo or non-interventional control group.
Pienimäki 1996 RCT	5.0	N = 39 with chronic lateral epicondylitis (required positive Mill's test and resisted wrist and/or middle finger extension plus local tenderness), most symptoms >3 months.	Exercise (PT appointment every other week with stepped slow repeated wrist and forearm stretches, muscle conditioning, occupational exercises. HEP 4-6 times a day) vs. ultrasound (0.3-0.7 W/cm^2, 10-15minutes a session, 2-3 times a week) for 6 to 8 weeks treatment; 8 week follow-up.	VAS pain at rest changes: Exercise -1.9±1.8 vs. US +0.2±2.6, p = 0.004. Pain under strain (p = 0.04), Working inability (p = 0.004), sleep disturbance (p = 0.01) all favored exercise. Isokinetic torque favored exercise group (p = 0.0002). No difference between groups for grip strength, manual provocative test; 6/8 (75%) of exercise group vs. 3/9(33%) of US group became able to work.	"[P]rogressive strengthening and stretching exercise treatment is more effective than pulsed ultrasound in treating chronic lateral epicondylitis: it reduced chronic pain and improved upper limb function and the ability to work of patients in the study. It may correct the ill-effects of prolonged immobilisation, counter patients' fear of using the forearm and hands, and help them to return to work."	Some details sparse. Data suggest exercise superior to US for chronic lateral epicondylitis. Outcomes data included return to work which differed between the groups.
Ultrasound as a Co-Intervention						
Struijs 2004 RCT	7.0	N = 180 with lateral epicondy-litis (lateral elbow pain aggravated with both epicondylar pressure and resisted wrist dorsi-flexion) for at least 6 weeks.	Brace-only (Velcro strap, Epipoint, daytime use continuously) vs. physical therapy (9 total sessions 7.5 minute ultrasound (Binder BMJ 85), friction massage 5-10 minutes, progressive exercise program, HEP 2 times a day) vs. brace plus physical therapy for 6 weeks. 26 weeks follow-up.	No differences in success between groups. Mean±SD patient satisfaction comparing group A (PT) vs. group B (Brace) vs. group C (Combination): After 6 weeks: 75±20 vs. 66±26 vs. 77±19; p (A-B)<0.05; P(B-C) <0.05. Pressure pain after 6 weeks: 17±37 vs. 22±33 vs. 30±30; p (A-C) <0.05.	"Conflicting results were found. Brace treatment might be useful as initial therapy. Combination therapy has no additional advantage compared to physical therapy but is superior to brace only for the short term."	Multiple co-interventions in physical therapy. No differences over 6 months-year. Data suggest minimal short term benefit of physical therapy at 6 weeks.
Stratford 1989 RCT	6.5 for phon-o-phor-esis N = 4.5 for	N = 40 with lateral epicondylar pain and tenderness on palpation (ECRL, ECRB, ECRB at	Ultrasound (1.3W/cm^2 continuous to 5W/cm^2 pulsed 6 minutes) plus placebo ointment without friction massage (n = 9) vs. ultrasound plus friction	25% each of phonophoresis and placebo groups deemed success (NS); 29% with friction massage successful vs. 21% without friction massage, p >0.05.	"The results suggest that the most cost effective method of treating the lateral epicondylitis patient is by ultrasound alone."	Small groups; score based on hydrocortisone vs. placebo. Other interventions not blinded. Marked differences in durations at baseline between groups (4.3, 2.1,

	fric-tion mas s-age	tendon body, ECRB plus tendon body), lateral elbow pain with resisted wrist extension and radial deviation during complete elbow extension. Average 2.1-5.4 months durations between groups.	massage (n = 11) vs. phonophoresis (n = 10) vs. phonophoresis plus friction massage (n = 10); 6 minutes for ultrasound, 10 minutes for friction massage 9 treatments, usually 3 a week.			5.2, 5.4 months) VAS pain scores, and gender. Suggests randomization failure. No differences in success between phonophoresis vs. placebo. Friction massage also does not appear successful.
Smidt 2002 RCT	6.5	N = 185 with lateral epicondy-litis (pain in lateral elbow, increased pain with epicondylar pressure and resisted wrist dorsi-flexion), subacute and chronic pain.	Wait and see (avoid provocative activities, ergonomic advice, paracetamol) vs. injection (1mL triamcinolone acetonide (10mg/mL) and 1mL lidocaine 2%; up to 3 injections) vs. physiotherapy (9 sessions of pulsed ultrasound, 2 W/cm^2 for 7.5minutes per session; deep friction massage, exercise program); 52 weeks follow-up	Main complaint improvement (3/6/12/26/52 weeks): wait and see (6±14/21±32/33±30/47 ±30/53±28) vs. injection (43±28/46±30/37±30/3 6±34/44±32) vs. physiotherapy (11±18/26±28/43±31/5 3±31/59±25). At 6/52 weeks success rates for injections were 92%/69%, physiotherapy 47%/91%, and wait and see 32%/83% (all NS).	"The decision to treat with physiotherapy or to adopt a wait-and-see policy might depend on available resources, since the relative gain of physiotherapy is small."	Large sample size. Physiotherapy group with mixed interventions. Confounders addressed age, gender, duration of current episode, dominant elbow affected, acute onset, concomitant neck disorders, previous episodes of elbow pain, putative cause, and use of analgesics during past week. Data suggest wait and see not different from physiotherapy, but trends towards physiotherapy. Data suggest injections superior short term, then trends to be inferior.
Struijs 2003 RCT	4.5	N = 31 with lateral epicondy-litis (lateral elbow pain, pain aggravated with pressure on epicon-dyle and pain with resisted	Group 1: manipulation (thrust technique, wrist extension, scaphoid bone manipulated ventrally 15 times, forced passive extension of wrist or extension against resistance, 2 times a week up	Success rate in Group 1 (3/6 weeks) 62%/85% vs. 20%/67% (p = 0.05/0.40). After 6 weeks, improvement in pain 5.2±2.4 vs. 3.2±2.1. After 6 weeks, grip strength mean increase: Group 1= 6.2 ±10.5 kg vs.4.0±11.7 kg (NS). No change in range of motion.	"Manipulation of the wrist appeared to be more effective than ultrasound, friction massage, and muscle stretching and strengthening exercises for the management of lateral epicondylitis and when there was a	Pilot study; small sample size; short-term follow-up. Comparison group had multiple co-interventions. Confounders addressed age, duration of complaints, pain rating (0-10), dominant arm affected. Baseline

		wrist extension). At least 6 weeks duration, mostly chronic.	to 9 treatments over 6 weeks) vs. Group 2: ultrasound (7.5 minutes pulsed US, 2W/cm^2) plus friction massage for 10minutes plus stretching and strengthening exercises; 6 weeks follow-up.		short-term follow-up. However, replication of our results is needed in a large-scale randomized clinical trial with a control group and a longer-term follow-up."	difference between groups with duration likely favoring combined therapies (14.2 vs. 9.3 weeks) and grip strength favoring manipulation. Manipulation performed by experienced PT – results may be over-estimated. No difference 6 weeks.
Langen-Pieters 2003 RCT	4.0	N = 13 with lateral epi-condylitis, criteria not described; mostly chronic and subacute	Chiropractic care [manipulation of elbow (posterior to anterior glide of radial head in pronation, medial to lateral and lateral to medial glide of humeroulnar and humeroradial joint and long-axis distraction of elbow), stretching, strengthening exercises] vs. ultrasound (3MHz, 1.5W/cm^2 for 5min). Average 2 treatments a week for 6 weeks; 6 weeks follow-up.	VAS pain scales (pre/3 weeks/post): chiropractic care (5.2±2.3/2.7±1.5/ 2.3±1.5) vs. US (3.5±1.0/ 2.6±1.5/0.7±0.6; p = 0.25, 0.72, 0.03). Pain free function (p = 0.041) also favored US.	"Continuous ultrasound is more effective than chiropractic care in reducing pain and improving PFF (pain free function) in lateral epicondylitis, but that chiropractic care is equally effective in improving grip strength. Combined therapy approach would be of most benefit."	Pilot study. Short-term follow up. Small sample size. Low power. No placebo control. Manipulation combined with stretching and strengthening precludes assessing effect of manipulation alone; 1 "complete recovery. Conclusion that combined therapy approach most beneficial not supported. Data suggest ultrasound superior.

Evidence for the Use of Manipulation and Mobilization for Lateral Epicondylalgia

There is 1 high- and 5 moderate-quality RCTs or randomized crossover experimental studies (one with two reports) incorporated in this analysis. There are 5 low-quality RCTs(190, 255, 256, 258, 260) (Radpasand 09) in Appendix 2.

Author/ Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
			Soft Tissue Mobilization			
Blanchette 2011 RCT	4.5	N = 30 with confirmed lateral epicondylitis by Cozen and Mill test. Data suggest mostly chronic lateral epicondylitis.	Control group (n = 15) received advice about ergonomics at a computer station, flexor/extensor stretching exercises, and 1st level analgesics (e.g., generic NSAID) vs.	Patient-Rated Tennis Elbow Evaluation (PRTEE) for control vs. experimental (baseline/6 wks/3 mos) mean ± SD (95% CI): 30 ± 18 (19-41)/25 ± 18 (13-36)/17 ± 13 (9-25) vs. 37 ± 19 (27-48)/15 ± 9 (10-20)/16 ± 10 (10-21). VAS scores: 39 ±	"This pilot study could not establish that the use of ASTM differs from the noninterventio nist approach in the treatment of LE."	Controls more chronic at baseline (43±50 vs. 22±25 months), likely biases in favor of STM. Methods not well written and unclear if both groups received control group treatments. Data suggest no benefit of soft tissue mobilization.

			experimental group (n = 15) with augmented soft tissue mobilization twice a week for 5 weeks.	29 (21-58)/21 ± 18 (10-32)/21 ± 17 (8-30) vs. 46 ± 23 (33-60)/16 ± 12 (9-22)/17 ± 17 (7-26). Pain-free grip (PFG) in kg: 26 ± 15 (17-35)/28 ± 14 (19-37) vs. 25 ± 14 (18-33)/27 ± 13 (20-34).		
Manipulation						
Coombes 2013 RCT	8.0	N = 165 with unilateral lat. epicondylalgia of at least 6 weeks duration. No recent injections.	Saline injection vs. corticosteroid injection to greatest tender point (triamcinolone 10mg plus 1mL 1% lignocaine) vs. physiotherapy (PT) plus saline injection vs. PT plus corticosteroid injection. PT [8x30-minute sessions plus HEP (2 times a day). Manipulation, concentric/eccentric, gripping, latex band exercises.] Follow-ups at 4, 8, 12, 26, and 52 weeks.	Glucocorticosteroid injections superior at 4 weeks (worse pain, resting pain, pain and disability and quality of life). At 1 year, corticosteroid injections associated with less complete recovery or much improvement (68/82 (83%) vs. 7881 (96%), RR = 0.86, NNT = -7.5, p=0.01). Greater recurrences (54% vs. 12%, NNT=-2.4, p<0.001). No differences between PT and no PT at 1year with 91% vs. 88%, p=0.25 complete recovery or much improvement.	"Among patients with chronic unilateral lateral epicondylalgia, the use of corticosteroid injection vs. placebo injection resulted in worse clinical outcomes after 1 year, and physiotherapy did not result in any significant difference."	Mostly chronic LE (>6weeks). Blinding to injection type, not PT. Less resting pain in corticosteroid injection only group at baseline. Uncontrolled NSAID use. PT individualized, precluding detailed assessments; 71-73% of patients guessed the injection type correctly, suggesting some unblinding. Data suggest short term efficacy of injection, but long-term worse results and no efficacy of PT.
Bisset 2006, 2009 RCT	7.0	N = 198 with tennis elbow; at least 6 weeks duration	Wait and see vs. injection (1ml quantity of 1% lidocaine with 10mg of triamcinolone acetonide in 1ml) vs. physiotherapy (elbow manipulation and therapeutic exercise, 8 treatments of 30 minutes plus HEP including resistant band over 6 weeks). All received information booklet and "practical advice."	Pain-free grip ratio at 3/6 weeks injection (vs. wait and see) favorable with 42.0 (32.6 to 51.3)/ 36.4 (26.5 to 46.3), (mean (95% CI)). At 26/52 weeks wait and see favorable with -19.6 (-33.0 to -6.2)/-12.1 (-23.6 to 0.3). At 6 weeks physiotherapy favorable over wait and see 20.1 (10.3 to 30.0), but at 52 weeks less favorable at 4.3 (-7.5 to 16.2). Injection favored	"Physiotherapy combining elbow manipulation and exercise has a superior benefit to wait and see in the first six weeks and to corticosteroid injections after six weeks, providing a reasonable alternative to injections in the mid to long term. The significant short term benefits of corticosteroid injection are paradoxically reversed after six weeks, with high recurrence rates, implying that this	Confounders addressed include removal of participants who did not adhere to protocol, assessment of non-protocol treatment, blinding (had assessor guess at end of study and conducted post-hoc analyses). Data suggest injections most successful short-term. Wait and see and physiotherapy equivalent at 1 year.

				over physiotherapy at 3/6 weeks with 31.2 (22.2 to 40.2)/16.3 (6.6 to 26.0), but at 26/52 weeks physiotherapy favorable with -30.1 (-43.1 to -17.2)/-16.4 (-27.9 to -4.8). Assessor severity rating at 3/6 weeks injection favorable over wait and see at 35.9 (28.3 to 43.4)/29.9 (22.2 to 37.7), but at 26/52 weeks wait and see favorable -17.5 (-26.2 to -8.9)/-8.3 (-15.2 to -1.3). Physiotherapy overall favorable over wait and see at 3/52 weeks 9.8 (2.3 to 17.3)/5.1 (-1.9 to 15.2). Injection at 3/6 weeks favorable over physiotherapy 26.1 (18.7 to 33.4)/15.0 (7.2 to 22.6), but at 26/52 weeks physiotherapy favorable -25.7 (-34.4 to -17.1)/-13.3 (-20.4 to -6.3). Mean (99% CI).	treatment should be used with caution in the management of tennis elbow."	
Vicenzino 2001 Randomized crossover experi-mental study	6.0	N = 24 with chronic lateral epicondylalgia. Tenderness, pain on hand dynamometer use, pain on resisted wrist extensor contraction or ECRB or stretching or extensor muscles. At least 6 weeks duration, mean 8 months.	Lateral glide mobilization vs. sham vs. no manual contact. 6 repetitions of manipulation with 15s rest interval between reps; pre/post experimental study	Three-way interaction between independent variables, unaffected vs. affected side and time (pre/during/post) for pain free grip strength (p <0.0001) (data not provided). Pain free grips increased from 107.53N to 156.02 to 151.77N with mobilization.	"This study provides evidence of the initial and substantial pain-relieving effects of a mobilization-with-movement treatment technique for chronic lateral epicondylalgia."	Adequacy of blinding/sham not assessed. No follow-up. Hypothesis generating study. Requires RCT with longer term follow-up for guidance.

Struijs 2003 RCT	4.5	N = 31 with lateral epicondylitis (lateral elbow pain, pain aggravated with pressure on epicondyle and pain with resisted wrist extension). At least 6 weeks duration, mostly chronic.	Group 1: Manipulation (thrust technique, wrist extension, scaphoid bone manipulated ventrally 15 times, forced passive extension of wrist or extension against resistance, 2 a week up to 9 treatments over 6 weeks) vs. Group 2: ultrasound (7.5 minutes pulsed US, $2W/cm^2$) plus friction massage for 10 minutes plus stretching and strengthening exercises; 6 weeks follow-up.	Success rate in Group 1 (3/6weeks) 62%/85% vs. 20%/67% (p = 0.05/0.40). After 6 weeks, improvement in pain was 5.2±2.4 vs. 3.2±2.1. After 6 weeks, grip strength mean increase: Group 1 = 6.2 ±10.5kg vs.4.0±11.7kg (NS). No change in range of motion.	"Manipulation of the wrist appeared to be more effective than ultrasound, friction massage, and muscle stretching and strengthening exercises for the management of lateral epicondylitis and when there was a short-term follow-up. However, replication of our results is needed in a large-scale randomized clinical trial with a control group and a longer-term follow-up."	Pilot study; small sample size; short-term follow-up. Comparison group had multiple co-interventions. Confounders addressed age, duration of complaints, pain rating (0-10), dominant arm affected. Baseline difference between groups with duration likely favoring combined therapies (14.2 vs. 9.3 weeks), grip strength favoring manipulation. Manipulation performed by experienced PT – results may be over-estimated. No difference 6 weeks.
Langen-Pieters 2003 RCT	4.0	N = 13 with lateral epicondylitis, criteria not described; mostly chronic and subacute	Chiropractic care [manipulation of elbow (posterior to anterior glide of radial head in pronation, medial to lateral and lateral to medial glide of humeroulnar and humeroradial joint and long-axis distraction of elbow), stretching, strengthening exercises] vs. ultrasound (3MHz, $1.5W/cm^2$ for 5 minutes). Average 2 treatments a week for 6 weeks; 6 weeks follow-up.	VAS pain scales (pre/3 week/post): chiropractic care (5.2±2.3/2.7±1.5/2.3±1.5) vs. US (3.5±1.0/2.6±1.5/0.7±0.6; p = 0.25, 0.72, 0.03). Pain free function (p = 0.041) also favored US.	"Continuous ultrasound is more effective than chiropractic care in reducing pain and improving PFF (pain free function) in lateral epicondylitis, but that chiropractic care is equally effective in improving grip strength. Combined therapy approach would be of most benefit."	Pilot study. Short-term follow up. Small sample size. Low power. No placebo control. Manipulation combined with stretching and strengthening precludes assessing the effect of manipulation alone; 1 with "complete recovery." Conclusion that combined therapy approach most beneficial is not supportable by presented evidence. Data suggest ultrasound superior.

Evidence for the Use of Massage and Friction Massage for Lateral Epicondylalgia

There are 4 moderate-quality RCTs incorporated into this analysis. There is 1 low-quality RCT(193) in Appendix 2.

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Friction Massage vs. Other Treatment						

Struijs 2004 RCT	7.0	N = 180 with lateral epicondylitis (lateral elbow pain aggravated with both epicondylar pressure and resisted wrist dorsiflexion) for at least 6 weeks.	Brace-only treatment (Velcro strap, Epipoint, daytime use continuously) vs. physical therapy (9 total sessions: 7.5 min ultrasound (Binder BMJ 85), friction massage 5-10 minutes, progressive exercise program, HEP 2x/day) vs. brace plus physical therapy for 6 weeks. 26 weeks follow-up.	No difference in success between groups. Mean±SD patient satisfaction Group A (PT) vs. Group B (brace) vs. Group C (combination): after 6 weeks: 75±20 vs. 66±26 vs. 77±19; p (A-B) <0.05; P (B-C) <0.05. Pressure pain after 6 weeks 17±37 vs. 22±33 vs. 30±30; p (A-C) <0.05.	"Conflicting results were found. Brace treatment might be useful as initial therapy. Combination therapy has no additional advantage compared to physical therapy but is superior to brace only for the short term."	Multiple co-interventions in physical therapy. No differences over 6 months-year. Data suggest minimal short term benefit of physical therapy at 6 weeks.
Stratford 1989 RCT	6.5 for phono-phoresis 4.5 for friction massag e	N = 40 with lateral epicondylar pain and tenderness on palpation (ECRL, ECRB, ECRB at tendon body, ECRB plus tendon body), lateral elbow pain with resisted wrist extension/ radial deviation during complete elbow extension. Average 2.1-5.4 months durations between groups.	Ultrasound (1.3W/cm^2 continuous to 5W/cm^2 pulsed for 6 min) plus placebo ointment without friction massage (n = 9) vs. ultrasound plus friction massage (n = 11) vs. phonophoresis (n = 10) vs. phonophoresis plus friction massage (n = 10); 6 minutes for ultrasound, 10 minutes for friction massage 9 treatments, usually 3 a week.	25% each of phonophoresis and placebo groups deemed success (NS); 29% with friction massage successful vs. 21% without friction massage, p >0.05.	"The results suggest that the most cost effective method of treating the lateral epicondylitis patient is by ultrasound alone."	Small groups. Score based on hydrocortisone vs. placebo. Other interventions not blinded. Marked differences in durations at baseline between groups (4.3, 2.1, 5.2, 5.4 months) VAS pain scores, and gender. Suggests randomization failure. No differences in success between phonophoresis vs. placebo. Friction massage also does not appear successful.
Smidt 2002 RCT	6.5	N = 185 with lateral epicondylitis (pain in lateral elbow, increased pain with epicondylar pressure and resisted wrist dorsiflexion) subacute and chronic pain	Wait and see (avoid provocative activities, ergonomic advice, paracetamol) vs. injection (1 mL triamcinolone acetonide (10 mg/mL) and 1 mL lidocaine 2%; up to 3 injections) vs. physiotherapy (9 sessions of pulsed ultrasound, 2 W/cm^2 for 7.5minutes/session; deep friction massage, exercise program); 52 weeks follow-up.	Main complaint improvement (3/6/12/26/52 weeks): wait and see (6±14/ 21±32/33±30/47±30/ 53±28) vs. injection (43±28/46±30/37±30 /36±34/44±32) vs. physiotherapy (11±18/ 26±28/43±31/53±31/ 59±25). At 6/52 weeks success rates for injections 92%/69%, physiotherapy 47%/91%, and wait and see 32%/83% (all NS).	"The decision to treat with physiotherapy or to adopt a wait-and-see policy might depend on available resources, since the relative gain of physiotherapy is small."	Large sample size. Physiotherapy group with mixed interventions. Confounders addressed age, gender, duration of current episode, dominant elbow affected, acute onset, concomitant neck disorders, previous lateral elbow pain episodes, putative cause, use of analgesics

						past week. Data suggest wait and see not different from physiotherapy, but trends towards physiotherapy. Data suggest injections superior in short term, then trends to be inferior.
Struijs 2003 RCT	4.5	N = 31 with lateral epicondylitis (lateral elbow pain, pain aggravated with pressure on epicondyle and pain with resisted wrist extension). At least 6 weeks duration, mostly chronic.	Group 1: Manipulation (thrust technique, wrist extension, scaphoid bone manipulated ventrally 15 times, forced passive extension of wrist or extension against resistance, 2 a week up to 9 treatments over 6 weeks) vs. Group 2: ultrasound (7.5 minutes pulsed US, 2W/cm^2) plus friction massage for 10 minutes plus stretching and strengthening exercises; 6 weeks follow-up.	Success rate in Group 1 (3/6weeks) 62%/85% vs. 20%/67% (p = 0.05/0.40). After 6 weeks, improvement in pain was 5.2±2.4 vs. 3.2±2.1. After 6 weeks, grip strength mean increase: Group 1 = 6.2 ±10.5kg vs.4.0±11.7kg (NS). No change in range of motion.	"Manipulation of the wrist appeared to be more effective than ultrasound, friction massage, and muscle stretching and strengthening exercises for the management of lateral epicondylitis and when there was a short-term follow-up. However, replication of our results is needed in a large-scale randomized clinical trial with a control group and a longer-term follow-up."	Pilot study; small sample; short-term follow-up. Comparison group had multiple co-interventions. Confounders addressed age, complaint duration, pain rating (0-10), dominant arm affected. Baseline difference between groups, duration likely favoring combined therapies (14.2 vs. 9.3 weeks) and grip strength favoring manipulation. Manipulation done by experienced PT – results may be over-estimated. No difference 6 weeks.

Evidence for the Use of Magnets for Lateral Epicondylalgia

There is 1 moderate-quality pseudorandomized clinical trial incorporated into this analysis.

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Uzunca 2007 Pseudo-randomized clinical trial	6.0 for PEMF 5.0 for cort. inject-tion	N = 60 with lateral elbow and forearm pain; duration more than 6 weeks	Pulsed electromagnetic field (Group I magnetotherapy, BTL-09, 6mT/ session, 25/4.6 Hz frequency, 30 minute sessions, 5 times a week 3 weeks) vs. placebo (sham,	Rest pain VAS (pre/post/3 months): Group I (3.43±2.56/1.05± 1.69/0.09±0.44) vs. Group II (3.39 ±2.08/1.95±1.75/ 1.79±1.93) vs. Group III (4.02±2.05/0.50±	"[P]atients treated with PEMF had lower pain levels during rest, activity, and nighttime when compared with patients treated with corticosteroid injections after 3	Pseudo-randomization by sequence in clinic. Durations differed at baseline (4.1 vs. 2.4 vs. 3.4 months) concerning for randomization failure. Blinding methods unclear. Score for PEMF vs. sham (score for injection 5.0).

			Group II) vs. methyl-prednisolone acetate 40mg plus prilocaine HCl 20mg/1mL (into most tender point, Group III). Follow-up "after 3 months."	0.69/1.40±2.09). All improved. Statistical results between groups not presented.	months, although pain during resisted wrist dorsiflexion and forearm supination maneuvers and algometric values were not different."	Highly intensive treatment regimen. Between group results not presented with data tables, qualitatively described as mostly negative.

Evidence for the Use of Extracorporeal Shockwave Therapy for Lateral Epicondylalgia

There are 3 high- and 8 moderate-quality RCTs incorporated into this analysis. There are 4 low-quality RCTs(268, 270, 271, 285) (Rompe 01) in Appendix 2.

Author/ Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Chung 2004 RCT	9.5	N = 60 with untreated lateral epicondyltis, 3 weeks-1 year duration	Extracorporeal shockwave therapy (2000 pulses of 0.03-0.17mJ/mm^2 in each session for 3 sessions) vs. sham extracorporeal shockwave therapy. Both groups treated with forearm stretching; 8 weeks follow-up.	Treatment Group: VAS (cm) Overall pain at 0 weeks median score (m) = 3.2, interquartile range (IR) 2.1-5.0 and at 8 weeks m=2.5, IR 1.4-4.8. Max pain-free grip strength (kg) at 0 weeks m = 23.4, IR 15.6-37.9, at 8 weeks m = 32.0, IR 24.0-45.8. Placebo Group: VAS (cm) Overall pain at 0 weeks m = 3.9, IR 2.1-4.9, at 8 weeks m = 2.0, IR 1.0-3.2. Max pain-free grip strength (kg) at 0 weeks m = 24.7, IR 14.7-36.0, at 8 weeks m = 30.0, IR 22.0-39.5.	"Despite improvement in pain scores and pain-free maximum grip strength within groups, there does not appear to be a meaningful difference between treating lateral epicondylitis with extracorporeal shock wave therapy combined with forearm-stretching program and treating with forearm-stretching program alone, with respect to resolving pain within an 8-week period of commencing treatment."	Excluded workers compensation. Confounders addressed: age, gender, weight, arm dominance, and duration of symptoms. Randomization appears successful. Data suggest ESWT ineffective.
Staples 2008 RCT	9.0	N = 68 with lateral elbow pain and 2+ signs of tenderness over epicondyle or extensor origin, resisted wrist extension and static stretching of pronated wrist in palmar flexion. Dur-ation at	Extracorporeal shock wave therapy (2,000 shocks a week) vs. sham (200 shocks a week, <0.03mJ/mm^2); 3 treatments a week for 3 weeks; 6 months follow-up.	Pain Index changes from baseline (6 weeks/3 months/6 months): ESWT (27.7/26.1/31.7) vs. sham (26.0/26.7/40.7), p = 0.31. No difference between groups at 6-week, 3-month, and 6-month follow-up for Pain Index, Function Index, Dash Function Score, Dash work and sport Score, Pain-Free Grip, Max Grip, and 8-item pain free function index.	"[T]here were no clinically meaningful differences between the ESWT and placebo groups at any of the follow-up time points for any of the measured outcome variables."	Data suggest lack of efficacy.

		least 6 weeks.				
Haake 2002 RCT	8.0	N = 272 with chronic lateral epi-condylitis (at least 2 posi-tive clinical tests, Roles and Maudsley score of 3 or 4, refractory to at least 3 injections, 10+ physio-therapy treatments and at least 10 indi-vidual treat-ments with physical forms of therapy)	Extracorporeal shockwave therapy (2000 pulses of 007-0.09mJ/mm²) vs. sham ESWT. Three weekly treatments. Local anesthesia with 3mL 1% mepivacaine and NSAID post treatment. 12 months follow-up.	Failures in ESWT 74.2% vs. sham 74.6% (NS). At the primary end point (12 weeks) 25.8% ESWT vs. 25.4% sham reported success (p = 1.00). Odds ratio for success of ESWT 1.02 (0.55-1.89). No differences at 12 months.	"Extracorporeal shock wave therapy as applied in the present study was ineffective in the treatment of lateral epicondylitis. The previously reported success of this therapy appears to be attributable to inappropriate study designs. Different application protocols might improve clinical outcome. We recommend that extracorporeal shock wave therapy be applied only in high-quality clinical trials until it is proved to be effective."	Patients with chronic lateral epicondylitis refractory to multiple, prolonged treatments; 1-year follow-up. Confounders addressed: age, gender, affected arm, symptom duration, and conservative therapy (brace, tape, cast, radiation therapy, analgesics, non-steroidal anti-inflammatory drugs. After study began, device used for measure-ments changed, but presumably non-differential impacts. Some co-interventions. Data suggest lack of efficacy.

Pettrone 2005 RCT	7.5	N = 114 with chronic lateral epicondy-litis at least 6 months duration.	Extracorporeal shockwave therapy (2000 pulses at 0.06mJ/mm^2 directed to maximal tenderness) vs. sham. Three weekly treatments; 12 weeks follow-up, then allowed crossover; 12 months total follow-up.	Pain (baseline/12 weeks): ESWT (74±15.8/37.6±28.7) vs. sham (75.6±16.0/51.3 ±29.7), p = 0.02. Function scale: ESWT (4.7±1.8/2.3±1.6) vs. sham (4.6±1.8/3.2±2.1), p = 0.01. Activity score and overall impression superior in ESWT. Grip strength trended (71±26.3/87.1±10 vs. 72.5±29.5/81.5±32.5, p = 0.09) Cross over patients had less pain.	"[L]ow-dose shock wave therapy without anesthetic is a safe and effective treatment for chronic lateral epicondylitis."	Data suggest ESWT improved most outcomes. Confounders addressed: age, race, gender, body habitus, affected arm, chronicity of pain, medical diagnoses, and prior treatments.
Rompe 2004 RCT	7.5	N = 78 with chronic lateral epicondyliti s (at least 2 clinical signs, increased signal intensity of extensors on MRI, at least 3 injections, at least 10 individual treatments with physical forms of treatment, at least 4/10 VAS pain) of at least 12 months duration.	Extracorporeal shockwave therapy (2000 pulses of 0.09mJ/mm^2 focused at maximal tenderness) vs. sham. Article describes multiple adjustments to focusing in ESWT group but not controls; three weekly treatments.	Mean pain scores (baseline/3 months/12 months): ESWT (7.1±1.4/3.6±2.1/3.1±2.4) vs. sham (7.1±1.6/ 5.12.1/4.3±2.3) 3 months. Difference 1.6 points (95% CI: 0.6-2.5; p = 0.0001); at 12 months difference 1.3 points (95% CI: 0.2-2.3; p = 0.019). At 3 months 25/38 (65.8%) vs. 11/40 (27.5%) sham, p = 0.001. At 12 months, 23/38 (60.5%) ESWT vs. 15/40 (37.5%) sham had 50% reduction, p = 0.0692.Grip strengths not different. Upper extremity function scale ESWT (50.3±7.9/26.9±14.9/ 25.2±15.3) vs. sham (49.1±8.1/38.2±14.8/ 30.6±16.7), p = 0.001 and p = 0.135 respectively.	"Low-energy extracorporeal shock wave treatment as applied is superior to sham treatment for tennis elbow."	Included only recreational tennis players. Confounders addressed age, gender, height, weight, duration of symptoms, MRI diagnosis, previous treatment. Selection/treatm ent bias. Patients not matched for activity level before treatment. Patients allowed to continue wearing braces already in use. Adverse effects reported included temporary reddening, pain, nausea. May have been different attention in ESWT group vs. sham. If attention bias not present, data suggest ESWT effective, otherwise data not interpretable.
Speed 2002 RCT	7.0	N= 75 with chronic lateral epicondy-	Extracorporeal shockwave therapy (1500 pulses at	Patients with at least 50% pain improvement in 35% ESWT vs. 34% sham	"There appears to be a significant placebo effect of moderate dose ESWT in subjects	Modest-sized groups. Confounders addressed age,

		litis (tenderness over lateral epicondyle at/near insertion plus pain reproduced with resisted MF extension) of at least 3 month duration	0.18mJ/mm^2) vs. sham extracorporeal shockwave therapy focuses on maximal tenderness point. One monthly treatment for 3 months; 3months follow-up.	(NS). At least 50% improvement in night pain in 30% ESWT vs. 43% sham (NS). VAS pain scores (baseline/3months): ESWT (73.4/47.9) vs. sham (67.2/51.5) (p<0.001 compared with baseline, but NS between groups).	with lateral epicondylitis but there is no evidence of added benefit of treatment when compared to sham therapy."	gender, weight, arm dominance, symptom duration, prior treatment. Baseline differences with more prior injections in ESWT (72.5% vs. 48.6%); unclear significance, possible bias against ESWT. No long-term follow-up or functional measures. Data suggest lack of efficacy.
Spacca 2005 RCT	7.0	N=62 with tennis elbow >10 mos.	Four weekly sessions of 2000 impulses/session (n=31) vs. four weekly sessions of 20 impulses/session (n=31). Follow-ups were at 0/6 months.	Median pain at rest score (VAS) comparing study group vs. control group: Before treatment 4.5 vs. 4.5; p=0.0635. After treatment 0.5 vs. 5; p<0.001. At follow up 0.5 vs. 6.5; p<0.001.	"[T]he use of RSWT allowed a decrease of pain, and functional impairment, and an increase of the painfree grip strength test, in patients with tennis elbow. The RSWT is safe and effective and must be considered as possible therapy for the treatment of patients with tennis elbow."	Chronic pain. Blinding not well described. Data suggest efficacy.
Ozturan 2010 RCT	4.0	N=60 diagnosed with lateral epicondylitis for at least 6 months. Follow-ups at 4, 12, 26, 52 wks.	All groups initially prilocaine 1mL to skin and SQ. Group 1 (CS) methylprednisolone acetate (1 mL) with 5 skin penetrations at tender point (n=20) vs. group 2 (AB) 2mL autologous blood to most painful part (n=20) vs. group 3, US gel and 1 ESWT with 2000 imp. at 0.17 mJ/mm² once a week for 3 weeks.	At 4 weeks CS superior functional score vs. other groups (p<0.001). At 52 weeks, AB and ESWT improved vs. CS (p<0.001). For Thomsen Provocation Test, only difference at 4 wks and CS favored over both groups (p<0.001). For grip strength mean improvement, at 4 week, corticosteroid was favored (p<0.05). At 26 weeks the extracorporeal shock wave therapy group made a greater improvement than corticosteroid injections (p<0.05). No other differences were seen.	"[C]orticosteroid injection provided a high success rate in short term. However, (AB) injection and (ESWT) gave better long-term results, especially considering the high recurrence rate with (CS). We suggest that the treatment of choice for lateral epicondylitis be (AB) injection."	More heavy work in CS>AB>ESWT. CS dose not provided. Data suggest EWST and AB comparable, and both superior to CS.
Rompe 1996 RCT	4.0	N = 115 with chronic tennis elbow (at least 2 positive	Extracorporeal shockwave therapy (1000 pulses of	Night pain (baseline/after treatment week 0/3 week/6 week/ 24	"There was significant alleviation of pain and improvement of function after treatment	Randomization process not described. Minimal

		tests: palpation of epicondyle, resisted wrist extension, resisted finger extension, chair lift test; unsuccessful conservative therapy prior 6 months) of at least 12 months duration	0.08mJ/mm2) vs. ESWT (10 pulses) focused on lateral epicondyle. Three weekly treatment sessions; 24 weeks follow-up.	week): ESWT (32.5 ±17.3/34.6±15.8/13.2 ± 9.9/7.7±8.8/7.3±8.7) vs. very low dose ESWT (29.9±15.6/31.2±16.0 /34.6±17.6/35.1±18.1/ 32.7±17.4), p <0.001 for weeks 3, 6 and 24. ESWT group scored better in night pain, resting pain, pressure pain, Thomsen test, finger extension, and chair test all (p <0.001).	in group I in which there was a good or excellent outcome in 48% and an acceptable result in 42% at the final review, compared with 6% and 24%, respectively, in group II. Our success with this new method of treatment warrants further study of the most efficient method of its use and the mechanism of its influence on pain."	baseline data. Loss to follow up of 15 participants not addressed. No intent to treat analysis. Control group received low-dose treatment (30 pulses), thus treatment duration likely shorter and attention bias probable. If data not substantially biased, suggest efficacy.
Mehra 2003 RCT	4.0	N = 47, 24 with tennis elbow and 23 with plantar fasciitis. Mean duration 11 months (minimum for eligibility not stated). All failed 1 or more conservative treatments ("conserva-tive, topical NSAIDs, steroid injection and/or surgery")	ESWT (mobile lithotripter) vs. Sham treatment (application of a clasp) Three treatments at 2 week intervals. Local injection with 3-5mL lignocaine. 6 months follow-up.	Treatment group mean score decreased 6.6 to 3.0 (no SDs provided) at 6 months vs. sham from 6.6 to 6.2. ESWT 10 patients (78%) with significant improvement, 1 no improvement, 2 increased pain vs. sham 1 significant improvement; 10 no change. States statistical significance, but no p value.	"The mobile lithotripter is an effective way of treating tennis elbow and plantar fasciitis but warrants further larger studies."	Mixed study included tennis elbow and plantar fasciitis. Scant baseline or results data. Data variance not provided. Unable to address baseline comparability of groups. Study both states failure of conservative treatment, but appears to have allowed post-op patients to enroll. Confounders addressed age, gender, duration of symptoms, and previous treatment. Provided data so restricted study has limited utility.
ESWT vs. Other Treatments						
Radwan 2008 RCT	6.0	N = 56 with lateral epicondylitis (pain with palpation, resisted wrist extension, chair test) with failure of conservativ	Extracorporeal shock wave (1500 shocks at 18kV, 0.22mJ/mm^2) vs. percutaneous release of extensor origin (Grundberg Clin Orthop 2000; 376:137). 12 months follow-up.	At 12 weeks, at least 50% improvement in Thomsen score in ESWT 21/29 (72.4%) vs. tenotomy 23/27 (85.2%). At 12 months, at least 80% improvement in Thomsen score in ESWT 14/29 (48.3%) vs.	"ESWT appears to be a useful noninvasive treatment method that reduces the necessity for surgical procedures."	Data suggest equal efficacy. May be underpowered for Thomsen scores.

		e treatment (NSAIDs, corticosteroid injections, PT, exercise, brace). Duration at least 6 months.		tenotomy 17/27 (63.0%). No differences in night pain, rest pain, pressure, Thomsen test, Chair test, grip at any time period.		

Evidence for the Use of Phonophoresis for Lateral Epicondylalgia

There are 4 moderate-quality RCTs incorporated into this analysis. There is 1low-quality RCT (219) in Appendix 2.

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Klaiman 1998 RCT	6.5	N = 49 with epicondylitis, tendinitis (bicipital, supraspinatus, Achilles, Patellar), tenosynovitis (de Quervain's), plantar fasciitis	Phonophoresis (gel containing 0.05% fluocinonide used as coupling agent) vs. Ultrasound (identical gel absent steroid), 1.5W/cm^2, 8 minutes a session, 3 times a week for 3 weeks. 3 weeks follow-up.	Both groups improved after 3 weeks ($p < 0.05$). No differences between groups (VAS: US 5.5-1.9, PH 5.0-2.0; algometry (involved limb): US 4.7 lb-7.1 lb, PH 5.1 lb-6.6 lb).	"US results in decreased pain and increased pressure tolerance in these selected soft tissue injuries. The addition of PH with fluocinonide does not augment the benefits of US used alone."	Mixed disorders included. Breakdown results by individual conditions not provided, also underpowered. Short-term follow-up. No placebo control. Without placebo/sham, both treatments equally effective or ineffective.
Stratford 1989 RCT	6.5 for phonophoresis N = 4.5 for friction massage	N = 40 with lateral epicondylar pain and tenderness on palpation (ECRL, ECRB, ECRB at tendon body, ECRB plus tendon body), lateral elbow pain with resisted wrist extension and radial deviation during complete elbow extension. Average 2.1-5.4 months	Ultrasound (1.3W/cm^2 continuous to 5W/cm^2 pulsed 6 minutes) plus placebo ointment without friction massage (n = 9) vs. ultrasound plus friction massage (n = 11) vs. phonophoresis (n = 10) vs. phonophoresis plus friction massage (n = 10); 6 minutes for ultrasound, 10 minutes for friction massage 9 treatments, usually 3 a week.	25% each of phonophoresis and placebo groups deemed success (NS); 29% with friction massage successful vs. 21% without friction massage, $p > 0.05$.	"The results suggest that the most cost effective method of treating the lateral epicondylitis patient is by ultrasound alone."	Small groups; score based on hydrocortisone vs. placebo. Other interventions not blinded. Marked differences in durations at baseline between groups (4.3, 2.1, 5.2, 5.4 months) VAS pain scores, and gender. Suggests randomization failure. No differences in success between phonophoresis vs. placebo. Friction massage also does not appear successful.

		durations between groups.				
Baskurt 2003 RCT	6.0	N = 61 with lateral epicondylitis (diagnostic criteria and duration not stated)	Naproxen gel (10%) by phonophoresis given through Pagani Ultrasound (1mHz, 1W/cm2) vs. naproxen gel (10%) given via Pagani Galvanic (0.08-0.004mA/cm^2). Both groups treated with cold, strengthening and stretching exercises. Average approximately 20 sessions each group. Average duration of follow-up 4.5±1.8months.	VAS pain scores (pre/ post): phonophoresis (3.62±2.73/1.12±1.18) vs. iontophoresis (3.15±2.45/0.72±1.85). Grip strength measures also improved, but no differences between groups. Pain severity decreased and grip strength increased, but neither statistically significant when compared with pre-treatment (p >0.05). Nirshl-Petterone Scoring System scores compared before and after also not significant (p >0.05).	"Results suggest that iontophoresis and phonophoresis of naproxen are equally effective electrotherapy methods in the treatment of lateral epicondylitis."	Multiple co-interventions. Many treatment sessions applied and varied considerably weaken conclusions considerably. Confounders addressed: age, gender and occupation. No placebo group and natural history is improvement, thus possible interpretation is also that both treatments are equally ineffective.
Nagrale 2009 RCT	4.0	N=60 with clinically identified teno-periosteal variety of lateral epicondylalgia longer than one month	Control treatment of phonophoresis with diclofenac gel for 5 min on lateral epicondyle and also participated in supervised exercise 3 times a week for 8 weeks (group A, n=30) vs. 10 minutes of deep transverse friction massage followed by one application of Mill's manipulation, 3 times a week for 8 weeks (group B, n=30).	Baseline- 4 week change: VAS (mean, 95%CI): group A 5.63(5.31, 5.95)vs. group B 3.83 (3.52, 4.14), p=0.000; Pain-Free Grip: group A 28.80 (27.21, 30.38) vs. group B 16.40 (15.07, 17.72)p=0.000. Function (Measured with Tennis Elbow Function Scale 0-40): group A 24.60 (23.41, 25.78) vs. group B 16.83 (15.70, 17.96), p=0.000. Baseline- 8 weeks change: VAS (mean, 95%CI): group A 5.03(4.62, 5.44) vs. group B 2.50 (2.12, 2.87), p=0.000; Pain-	"[T]he results of this study demonstrate that Cyriax physiotherapy is a superior treatment approach compared to phonophoresis and exercise in managing lateral epicondylalgia".	Does not specify how patients were randomized.

				Free Grip: group A 25.46 (23.13, 27.80) vs. group B 10.93 (9.38, 12.48) p=0.000. Function (Measured with Tennis Elbow Function Scale 0-40): group A 20.93 (19.30, 22.56) vs. group B 11.90 (10.64, 13.15), p=0.000.		

Evidence for the Use of Low-Level Laser Therapy for Lateral Epicondylalgia

There is 1 high- and 12 moderate-quality RCTs incorporated into this analysis. There are 2 low-quality RCT(292, 303) (Emanet 10) in Appendix 2.

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Vasseljen Scand J Rehabil Med 1992 RCT	8.0	N = 30 with subacute and chronic lateral epicondylitis, duration 1-12 months	Laser treatment (GaAs, 904nm, 880Hz, 175ns, 1.5mW) vs. sham, 3 times a week, 8 treatments total; 5-6 months follow-up.	Patient's judgment of progress (end of treatment/4 weeks): much better/no pain Laser [3/15 (20%)/ 7/15 (46.7%)] vs. sham [0/15(0%)/3/ 15(20%)]. Identical numbers worse at all times (13.3%). VAS pre/post favored laser (p = 0.024), but overall modest benefit (see Figure); no differences between groups at any specific follow-up time.	"[A]ctive laser does have a significant effect on tennis elbow with regards to decreased pain measured VAS, increased grip strength measured by the ability to lift free weights...however, as a sole treatment for lateral epicondylitis it is of limited value."	Laser group appears to be same group used for below study comparing with another arm (physiotherapy). This suggests these are 2 reports of 1 trial with 3 treatment arms; however this is not clearly described in this report. Small sample sizes. Tendency towards more patients on sick leave at baseline (73% vs. 53%, p = 0.23), presumably bias in favor of laser. Data suggest possible minimal benefit.
Basford 2000 RCT	7.0	N=52 with lateral epicondy-litis (criteria unclear) of at least 4 weeks duration	Laser treatment (1.06-µm Nd:YAG) vs. placebo. 7 sites irradiated for 60s each. 12 sessions. All self-treated with ice massage, friction massage, wrist extensor stretching. 60 days follow-up.	No significant differences were found in pain, maximal tenderness on palpation, overall change, grip strength, pinch strength, pin with grasp and pain with pinch.	"Treatment with low intensity 1.06-microm laser irradiation within the parameters of this study was a safe but ineffective treatment of lateral epicondylitis. Further research seems warranted in this controversial area."	Study included multiple co-interventions. Short-term follow-up. Groups did not differ significantly in terms of activity, duration of symptoms, medication use, gender, age, orthotic use, or previous treatment. Subject selection. 5-cm diameter laser aperture larger than typically used. Data suggest lack of efficacy.

Krasheninni-koff 1994 RCT	6.5	N = 48 with lateral epicondylitis (tender to palpation and/or tender points in forearm extensor muscles with aggravation with forced extension of hand) of at least 4 weeks duration.	Laser treatment (Ga-Al-As, 30mW/830nm, 3.6J/point) vs. sham. Targeted tender points of lateral epicondyle and forearm extensors. Treatments 2/ week, 8 total; 10 weeks follow-up.	No pain post/10weeks in laser 2/18 (11.1%)/6/18(33%) vs. sham 3/18(16.7%)/6/18(33%) (NS). No differences in pain ratings, VAS, dynamic muscle test, tender points at any time.	"[L]ow power laser offers no advantage over placebo in the treatment of musculoskeletal pain as lateral epicondylitis."	Baseline comparability satisfactory, although pseudorandomization with allocation by even/odd days at entry. Data suggest lack of efficacy.
Haker 1990 RCT	6.5	N = 49 with lateral epicondylitis (at least 2 tests positive, palpation, resisted wrist extension, passive stretching, resisted finger extension); duration at least 1 month.	Laser treatment (Ga-As 904 nm, mean power output 12 mW, peak value 8.3 W, and frequency 70 Hz) vs. sham. Applications to acupuncture sites LI 10, 11, 12; Lu5, SJ5, for 30s/point, 0.36J/point. 2-3 times a week, total 10 treatments. 12 month follow-up.	Excellent or good results after treatments in laser 5/23 (21.7%) vs. 12/26 (46.2%) sham. No statistical difference was observed between the laser group and the placebo group in relation to the subjective and objective outcome after 10 treatments.	"Results do not support the use of laser treatment with the chosen parameters."	While using acupuncture points for locations, still addresses lateral elbow applications, Data trended in favor of sham and suggest lack of efficacy.
Haker Arch Phys Med Rehabil 1991 RCT	6.5	N = 58 with lateral epicondylitis (at least 2 tests positive, palpation, resisted wrist extension, passive stretching, resisted finger extension); duration at least 1 month.	Laser treatment (Ga-As, 904nm, 4mW, peak power 10W, 3800Hz, 190ns, divergence 70mrad plus He-Ne 632.8nm, continuous, 5mW, divergence 60mrad) vs. sham. Applications to acupuncture sites LI 11, LI 12 for 2 min/point; 3-4 times a week, total 10 treatments; 12 month follow-up.	No differences in multiple measures (pain, resisted wrist extension, stretching middle finger, resisted pronation, resisted supination, lifting test). Vigorimeter results favored sham.	"Our results do not support the use of Space Mid Laser Mix 5-up laser treatment with the chosen parameters in lateral epicondylalgia."	No significant baseline differences other than gender (p <0.06) of uncertain impact. Blinding method for provider unclear. Applications to acupuncture sites, though lateral epicondylar area. Data suggest lack of efficacy.

Haker J Pain Symptom Manage 1991 RCT	6.0	N = 49 with lateral epicondylitis (at least 2 tests positive, palpation, resisted wrist extension, passive stretching, resisted finger extension); duration at least 1 month.	Laser treatment (Ga-As, 904nm, mean power 12mW, peak power 8.3W, 70Hz, pulse train 8000Hz) vs. sham. Applications to 6 sites around the elbow, 30s/site, 0.36J/point; 2-3 times a week, total 10 treatments; 12 months follow-up.	Apparently negative results for pain ratings (data not provided). Vigorimeter results in kPa (baseline/ post/3 months/1 year): laser (38/25/ 40/48) vs. sham (39/0/12/46), p <0.01 at post and 3 months, but NS at other times. (Explanation for 0 value not provided/ not logical). Middle finger test, lifting 3 and 4 kg and vigorimeter all favored laser at posttreatment evaluation. At 3 months, only lifting 3kg and vigorimeter favored laser and none significant at 12 months.	"Patients suffering from lateral epicondylalgia who were treated with Irradia laser obtained a more significant improvement in objective measurements than patients treated with placebo laser." "Low energy laser may be a valuable therapy in lateral epicondylalgia if carried out as described."	Minimal demographics provided. Minimal quantitative results. Members of the 2 groups had a similar pretreatment condition. Results given as positive, but quantitative data suggest no long term efficacy.
Lundeberg 1987 RCT	4.5	N = 57 with tennis elbow (pain, point tenderness over lateral epicondyle, aggravation by resisted wrist dorsi-flexion, middle finger extension and resisted isometric forearm extension); at least 3 months duration.	Laser (Ga-As, 904nm, 0.07mW, 73Hz) vs. Laser (He-Ne, 632.8nm, 1.56mW) vs. placebo. Treatments to acupuncture points (Li10, 11, 12; Sj5, 10; Si4, 8; H3, 4; P3), 2/week for 5-6 weeks, 10 total treatments. 3 months follow-up.	Satisfactory outcomes in 6 He-Ne, 7 Ga-As and 6 placebo (NS). Mean VAS improvements: placebo 2.2±0.2 vs. He-Ne 2.4±0.2 vs. Ga-As 2.6±0.2. No differences in pain with resisted wrist dorsiflexion, pain on weight test and improvement in grip strength in extension.	"[L]aser treatment is not significantly better than placebo in treating tennis elbow."	No baseline data to compare groups. Data suggest lack of efficacy.
Papadopoulos 1996 RCT	4.0	N = 29 with 31 cases of tennis elbow.	Laser (Ga-Al-As, 820nm, 50mW, 0.4W/cm^2, 5KHz, pulse duration 160ns) vs. placebo to most tender point; 3 treatments a week for 2 weeks.	VAS pain scores lower at 3rd and 7th sessions for placebo group (p = 0.032 and p = 0.045 respectively.	"LLLT at the dosage and duration used in this study is without benefit in the short-term management of painful tennis elbow."	Limited data. Some methods sparse, but double-blinded. Data suggest lack of efficacy.
Low-Level-Laser Therapy Plus Other Treatments						

Vasseljen Physiotherapy 1992 RCT	7.5	N = 30 with lateral epi-condylalgia confined to teno-periosteal junction of the extensor carpi radialis brevis	Laser treatment (GaAs, 904nm, 880Hz, 175ns, 1.5mW) vs. physiotherapy (pulsed ultrasound plus deep friction massage), 3x/week, 8 treatments total; 5-6 months follow-up.	VAS scores decreased more with physiotherapy (5.1 to 1.8, interpretation of graphic data) vs. laser (4.2 to 2.8), p <0.01.Patient's judgment of much better/no pain at 4 weeks were 7/15 (46.7%) laser vs. 10/15 (66.7%) physiotherapy.	"[L]ow-level laser therapy as well as combined physiotherapeutic method of pulsed ultrasound and deep friction massage does have a significant effect on the symptoms of tennis elbow, both on subjective and objective assessments….In the treatment of tennis elbow, low-level laser therapy was no better than a traditional physiotherapeutic approach of deep friction massage and pulsed ultrasound."	Laser group is same group used for above study comparing with sham laser, and thus these reports are 2 reports of one trial with 3 arms. Tendency towards more sick leave in traditional physiotherapy group (p = 0.23). No placebo/sham group, thus cannot address efficacy of laser solely with this report.
Stergioulas 2007 RCT	6.0	N = 50 with lateral epicondylitis (tenderness, pain on resisted wrist extension, passive wrist extensor muscle stretch, passive extension of middle finger); duration at least 5 weeks (mean 6 years).	Plyometric exercise plus either low level laser therapy (Ga-As 904nm, 50Hz, 40mW, 2.4J/cm^2) vs placebo (sham) laser therapy, 2 sessions a week for weeks 1-4 then 1 a week; 12 total sessions; 8 weeks follow-up.	Pain at rest (pre/8 week/16 weeks): laser (6.95±9.81/ 3.41±6.26/1.61± 3.30) vs. sham (6.10±8.43/4.75± 7.63/2.93±3.11). At 8-week follow-up, LLLT had better range of motion (p <0.01), grip strength (p <0.01), and free weight elevation (p <0.005) vs. placebo.	"[A] combination of a 904 nm, 40 mW at 60HZ, 2.4J/cm2 laser, along with plyometric exercises and stretching is more effective than placebo laser and exercise in the treatment of patients with LE."	Study addresses additive benefit. Baseline data appear to exclude dropouts and are sparse. Blinding not well described. Presented results mostly compared with baseline rather than between groups (not well reported). A few results favored laser, but many apparently negative.
Öken 2008 RCT	5.5	N = 58 with lateral epicondylitis (lateral elbow pain, tenderness, pain on resisted wrist extension). Duration at least 1mo (means 3.5-6.2).	Brace (Orthocare 3125) during daytime for 2 weeks vs. ultrasound (1MHz, 1.5W/cm2 for 5 minutes, 5 days a week for 2 weeks) vs. low level laser therapy (He-Ne, 632.8nm, 10mV). All performed HEP (stretching and strengthening); 6 weeks follow-up.	VAS pain (pre/Week 2/Week 6): brace (8.1±1.3/4.8±2.6/6.7±0.9) vs. US (7.8±1.5/6.4±3.1/5.7±2.2) vs. laser (7.1±1.4/4.4±2.2/4.3±1.2), p = 0.097, 0.189, 0.067. Grip strengths: brace (43.7/46.3/36.2) vs. US (45.1/44.4/43.6) vs. laser (45.8/54.8/ 56.3) (all NS).	"[A] brace has a shorter beneficial effect than US and laser therapy in reducing pain, and that laser therapy is more effective than the brace and US treatment in improving grip strength."	All received exercises. Co-interventions not controlled. Some trends in baseline differences with lower pain in laser group and longer duration (3.5 vs. 4.3 vs. 6.2mo). Grip strengths do not appear entirely consistent/logical if significant pain. No placebo or non-interventional control group.

Lam 2007 RCT	4.0	N = 39 with pain over the lateral epicondyle, tenderness, pain with resisted middle finger extension, and pain with passive stretch of extensor muscle group. No dropouts.	Standard exercise program (stretch and strengthen) for all, including HEP. Low level laser therapy (Ga-As, 904nm, 25mW, pulse duration 200ns, 4.0mm diameter, 0.275J/tender point) vs. sham. 9 sessions. 6 week follow-up.	Work DASH (baseline/session 5/9/3 weeks): Laser (42.2±22.0/33.46±22.05/25.05±16.99/14.74±13.04) vs. placebo (41.82±20.62/38.69±18.86/34.79±18.81/27.36±17.22), p = 0.96/ 0.45/0.11/0.017. Laser group had greater mechanical pain threshold (p <0.001 at 3 weeks), maximum grip strength (p = 0.011), and VAS score (p = 0.000) at 3 weeks.	"LLLT demonstrated significantly greater analgesic effects than did placebo irradiation in terms of mechanical pain threshold and VAS."	Randomization method unclear (states draw lots, non-replacement, but groups unequal in size). Trends towards worse status at baseline in sham group. Blinding methods not well described. Study includes exercise program for all, thus attempts to address additive benefit. No intermediate or longer follow-up.
Stasinopoulos 2009 Quasi-randomized trial	4.0	N=50 with lateral epicondylitis for at least 4 weeks.	Exercise and low level laser therapy (904-nm Ga-As laser in continuous mode, and power density was 130 mW/cm², and dose was 0.585 J/point, n=25) vs. exercise and polarized polychromatic non-coherent light (Bioptron 2 used to administer dose perpendicularly to the lateral epicondyle at 3 points at an operating distance of 5-10 cm for 6 minutes at each position, n=25). Follow-up at 4 and 16 weeks.	No significant differences were found.	The authors concluded that "an exercise program consisting of eccentric and static stretching exercises, and LLLT or polarized polychromatic non-coherent light are both adequate treatment modalities for patients with LET."	Quasi-randomized with every other allocation. Patients not well described. Data suggest comparable (in) efficacy; 16 weeks follow-up.

Evidence for the Use of Acupuncture for Lateral Epicondylalgia

There are 6 moderate-quality RCTs (one with two reports) incorporated into this analysis. There is 1 low-quality RCT in Appendix 2.(313) (Tsui 02)

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Acupuncture vs. Sham Acupuncture or Placebo						
Fink 2002 a,b	6.0	N = 45 with chronic lateral	Acupuncture (6 needles, LI 4,10, 11; L5, SJ5, Ah-Shi over	At 2 weeks, reduced pain on motion (-43.3%	"Results suggest that, in the treatment of	Two reports of 1 trial. Modest sample sizes. No

RCT		epicondylitis (lateral elbow pain, aggravated by overhand gripping or arm exertion, epicondylar tenderness, aggravation during resisted wrist extension and middle finger test) at least 3 months duration	muscle origin of lateral extensor group, mechanically stimulated, de qi, 25 min needle placement) vs. sham acupuncture (6 needles, non-acupuncture points at least 5cm away from classical points otherwise same as other treatment arm); 2 treatments a week for 10 treatments; 1 year follow-up.	vs. -13.7%, p = 0.001) and pain on exertion (-41.8% vs. -17.9%, p = 0.007) in favor of real acupuncture. Pain on exertion decreased 4.09±0.83 to 0.54±0.78 in real acupuncture vs. 4.05±0.83 to 1.07±1.44 in sham at 1 year (NS). No outcomes significant other than at 2 weeks other than DASH which also was different at 2 months (p <0.05).	chronic epicondylitis, the selection of so-called real acupuncture points gives better results than invasive sham acupuncture at early follow-up. This additional effect can be interpreted as a specific effect of real acupuncture…. The treatment of epicondylitis with acupuncture might be a useful alternative to classical conservative methods in chronic epicondylitis, and where other treatment modalities have failed."	non-invasive group. Confounders addressed age, gender, disease duration. Unclear if a specific effect of the selection and stimulation of specific acupuncture points as insertion of a needle at any site can alleviate pain. Stimulation of true acupuncture points may have produced some attention bias, with bias in favor of that group. No objective measurement. Pain on exertion decreased over 1 year suggesting natural history is resolution. Data suggest slight benefit at 2 weeks, but not at 2 months or longer. No evidence of long-term benefit.
Haker Clin J Pain 1990 RCT	4.5	N = 86 with lateral elbow pain and 2+ of: tenderness over lateral epicondyle, resisted wrist extension, passive extensor stretching, resisted finger extension. Duration at least 1 month	Deep vs. superficial acupuncture (subcutaneous only). LI10, 11, 12, Lu5, SJ5. Only deep were manually stimulated, de qi Q5min in 20min period. 10 treatments.	Vigorimeter results in kPa (pre/post/3 months/12 months): deep (32/32/47/62) vs. superficial (33/10/37/55), p <0.05 at post only, others NS.	"[C]lassical "deep" acupuncture is superior to superficial needle insertion in the short-term symptomatic treatment of lateral epicondylalgia, but not at 3- and 12-month follow-up."	Baseline demographic data between groups not provided. Sparse results, data/some methods sparse. Manual stimulation of needles may produce attention bias. Minimal, short-term benefit of deep vs. superficial acupuncture that did not last 3 months. However, positive results seem to be driven by decline in function at post-treatment which is not explained.

Molsberger 1994 RCT	4.5	N = 48 with mostly chronic tennis elbow (diagnostic criteria unclear) at least 2 months duration	Acupuncture verum [GB34 (distal site on lower extremity), de qi] vs. placebo [UB13 (thoracic vertebra), not inserted but stimulated]. One treatment. 3 days follow-up.	Mean pain relief in verum group 55.8% ±2.95 vs. placebo 15%±2.77. After treatment, 19/24 (79.2%) verum reported at least 50% pain relief vs. 6/24 (25%), p <0.01. Mean duration pain relief verum 20.2± 21.54 vs. 1.4±3.50 hour, p <0.01.	"Non-segmental verum acupuncture has an intrinsic analgesic effect in the clinical treatment of tennis elbow pain which exceeds that of placebo acupuncture."	Ability to blind/sham dubious. Short-term follow-up of 72 hours for 1 treatment, thus data not usable for evidence-based treatment guidance.
Acupuncture vs. Other Type of Acupuncture						
Yong 1998 RCT	4.0	N = 93 with acute lateral epicondylitis (diagnostic criteria not stated). Duration range 1-27 days	Floating acupuncture (FA, targets tender point, no needle stimulation or de qi, needle taped in place for 1-2 days, then 1 day without needling but with 1-finger massage 10-minutes, then apparently cycle repeated though not clearly stated) vs. routine acupuncture (RA, LI11, SI9, SJ5, electrostimulated for 20 minutes, daily for 6 days, then rest day, then another cycle).	Response to one treatment favored floating acupuncture (complete relief 81.5% vs. 22.2%, p <0.01). At 10 days, complete recovery in 100% floating vs. 91.2% routine.	"FA (Fu's) was more effective than RA (routine acupuncture) in producing pain relief, especially during the first treatment. FA took less time and fewer treatments to produce complete recovery from the symptoms of lateral epicondylitis."	Study evaluates unique type of acupuncture ("Fu's"), with proponent (Dr. Fu) as an author. Needle retained for 1-2 days, and treatments daily thus practicality questionable. Strong probability of attention bias due to retained needle. Many details sparse.
Acupuncture vs. Other Treatment						
Davidson 2001 RCT	4.5	N = 16 with lateral epicondylitis (lateral pain, aggravation with activity, pain with resisted wrist extension combined with radial deviation or physician diagnosis). At least 3 weeks duration.	Ultrasound (4:1, 1MHz, 1W/cm^2 for 10min) vs. acupuncture (LI4, 10, 11, 12, TW5 for 20 min, manually stimulated, de qi). Both groups 2-3 times a week for 8 total treatments. Both groups treated with forceful stretching; 8 days follow-up.	VAS pain scores (baseline-treatment 1/treatment 4/ treatment 8): US (46.50±26.91/43.78±27.32/32.69±29.21) vs. Acupuncture (39.63±29.51/34.88±20.06/13.63±13.79), NS. Pain free grip strength scores increased US 6.08 ±4.19 to 11.96± 12.28 (96.7%) vs. acupuncture 10.25±5.84 to 14.09±9.53 (37.5%).	"Results suggest both ultrasound and acupuncture are effective in treating lateral epicondylitis."	Small sample sizes. Pilot study. No placebo/sham control group(s). Acupuncture group trended towards less pain and greater function at baseline. Unequal treatment times favoring acupuncture. No follow-up beyond last treatment date. Data suggest equal (in)efficacy, though underpowered.
Acupuncture (Other)						
Haker Pain 1990	6.5	N = 49 with lateral epi-condylalgia	Laser treatment (904 nm, mean power output 12 mW, peak value 8.3 W, and	No statistical difference observed between laser group and	"Results do not support the use of laser treatment with the chosen	This trial, while using acupuncture points, is not a true trial of

RCT			frequency 70 Hz) vs. placebo.	placebo group in relation to subjective and objective outcome after 10 treatments.	parameters."	acupuncture. Non-significant results favor placebo treatment group.

Evidence for Biofeedback, Transcutaneous Electrical Nerve Stimulation, Electrical Stimulation, and Diathermy for Lateral Epicondylalgia

There is 1 high-quality randomized crossover trial incorporated into this analysis for electrical stimulation.(314) There is 1 low-quality RCT(315) on electrical stimulation and 1 low-quality randomized crossover trial on TENS (316) (Weng 05) in Appendix 2. There are no quality trials evaluating biofeedback, transcutaneous electrical nerve stimulation, or diathermy for the treatment of lateral epicondylalgia.

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Electrical Stimulation						
Johannsen 1993 Randomized crossover trial	8.0	N = 16 with chronic lateral epicondylitis (pain and/or tenderness, aggravation with hand dorsiflexion in pronation against resistance and firm gripping). 10 sessions over 3 weeks, then 1 week off, then crossover. Duration mean 6 months (3-12 months).	Rebox (0-300µA, 0-20V, 200-5,000Hz) vs. sham (same box de-activated). 3 weeks treatment each arm. Pre/post, but no longer term follow-up.	Graphic data presented. Grip strengths, pain at elevation reportedly better with active treatment.	"We found a significant effect of Rebox compared to placebo in respect to all the subjective and the objective variables."	Relatively small sample size. Targeted racket sports clubs. Electrical current used not specified. Unclear if blinding successful as not reported. High quality score for individual measures, but low sample size and sparse results precludes strong conclusions.

Evidence for the Use of Glucocorticosteroid Injections for Lateral Epicondylalgia

There are 6 high- and 15 moderate-quality RCTs or pseudorandomized controlled trials (one with two reports) incorporated into this analysis. There are 3 low-quality RCTs(179, 244, 321) in Appendix 2.

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Glucocorticosteroid Injections vs. Placebo						
Krogh 2013 RCT	9.0	N = 60 with lateral epicondylitis for at least 3 months. No injections in past 3 months. Also used ultrasound for diagnosis and following.	Triamcinolon [sic] 40mg plus lidocaine (GC) vs. Saline (NS) vs. Platelet Rich Plasma injections (from 27mL whole blood, concentrated and buffered). US-guided injections. PRP and saline peppering technique (~7tendon injx).	Changes in pain from baseline (PRP/NS/GC) at 1 month: -0.5/-1.7/-9.8. At 3 months: -6.0/-3.3/-7.1. Disability chnage at 1 month (PRP/NS/GC): -5.2/-3.4/-21.9. Disability at 3 months: -16.6/-7.6/-13.8. No diferences between groups in ultrasound Doppler findings, or tendo thickness.	"Neither injection of PRP nor glucocorticoid was superior to saline with regard to pain reduction in LE at the primary end point at 3 months. However, injection of glucocorticoid had a short-term pain-reducing effect at 1 month in contrast to the other therapies."	Some baseline differences, especially more chronic in GC group, presumably biases against GC efficacy. Three month endpoint after which high dropouts and intended to do 12 month study, but 12 month data compromised with the dropouts. Data suggest GC superior and only

			GC injection only at deepest aspect common tendon origin. Follow-up at 4 weeks, 3, 6, and 12 months.			in 4 week timeframe.
Coombes 2013 RCT	8.0	N = 165 with unilateral lateral epicondylalgia of at least 6 weeks duration. No recent injections.	Saline injection vs. corticosteroid injection to greatest tender point (triamcinolone 10mg plus 1mL 1% lignocaine) vs. physiotherapy (PT) plus saline injection vs. PT plus corticosteroid injection. PT [8 x 30-minute sessions plus HEP (2x/day). Manipulation (Vicenzino 2003), concentric/eccentric, gripping, latex band exercises.] Follow-ups at 4, 8, 12, 26, and 52 weeks.	Glucocorticosteroid injections superior at 4 weeks (worse pain, resting pain, pain and disability and quality of life). At 1 year, corticosteroid injections associated with less complete recovery or much improvement (68/82 (83%) vs. 7881 (96%), RR = 0.86, NNT = -7.5, p = 0.01). Greater recurrences (54% vs. 12%, NNT = -2.4, p<0.001). No differences between PT and no PT at 1year with 91% vs. 88%, p = 0.25 complete recovery or much improvement.	"Among patients with chronic unilateral lateral epicondylalgia, the use of corticosteroid injection vs. placebo injection resulted in worse clinical outcomes after 1 year, and physiotherapy did not result in any significant difference."	Mostly chronic LE (>6weeks). Blinding to injection type, not PT. Less resting pain in corticosteroid injection only group at baseline. Uncontrolled NSAID use. PT individualized, precluding detailed assessments; 71-73% of patients guessed injection type correctly, suggesting some unblinding. Data suggest short term efficacy of injection, but long-term worse results and no efficacy of PT.
Lindenhovius 2008 RCT	8.0	N = 64 recruited, 48 finished follow-up Patients with lateral elbow pain.	Dexamethasone 4mg plus lidocaine 1% (2mL total) vs lidocaine 1% 2mL injection. Injected to site of maximal tenderness and "multiple needle redirections." 6 reinjections of steroid (2 dex vs. 4 placebo); 6 months follow-up.	DASH scores (pre/1 month/6 months): Dex (31/24/18) vs. placebo (29/27/13), (p = 0.72). VAS scores Dex (5.8±4.7/3.7/2.4) vs. placebo (4.6±2.0/4.3/1.7), (p = 0.42). Grip strength based on percentage not different (p = 0.57).	"[T]here were no differences in perceived arm-specific disability, pain, and grip strength at 1 and 6 months after injection between patients treated with a corticosteroid injection and those treated with a placebo injection."	Study aim to assess differences in disability at 6 months. Data suggest a modest trend in favor of injection at 1 month, but no meaningful differences at 6 months.
Hay 1999 RCT	7.5	N = 164 with lateral epicondylitis (pain and tenderness and pain on resisted isometric wrist extensor contraction) No treatment	Naproxen 500mg BID for 2 weeks vs. placebo (unmarked vitamin C) BID 2 weeks) vs. methylprednisolone 20mg plus 0.5 mL 1% lignocaine injection 1cm distal to lateral	Percentages better (pain score ≤3) (4 weeks/6 months/12 months): injection (82/65/84) vs. naproxen (48/81/85) vs placebo (50/83/82). Injection superior at 4 weeks (p <0.0001). Naproxen or placebo vs. injection slightly favored at 6/12	"Early local corticosteroid injection is effective for lateral epicondylitis. Outcome at one year was good in all groups, and effective early treatment does not seem to influence this."	Confounders addressed: age, gender, social class, duration of pain, work status, general health, movement and strength, and disability. Local skin atrophy at the lateral epicondyle in 2 at 6 months and 1 at 12

		prior 12 months. Duration unclear, with approx 1/3 chronic.	epicondyle towards tender point; 12 months follow-up.	months.		months. Naproxen discontinued in 4 due to GI adverse effects. Data suggest comparable efficacy.
Lewis 2005 RCT Same study as Hay 99 above	7.5	N = 164 (same as above)	Injection (20mg methylpredniso-lone plus 0.5 mL 1% lignocaine) 1cm distal to epicondyle towards most tender point vs. naproxen (200mg BID) vs. placebo; 5-day duration of observation.	Naproxen and injection groups both improved by day 3 (p <0.01). Injection improved better than other 2 groups over 5 days, (p <0.05).	"Steroid injection was associated with an increase in reported pain for the first 24 hours of treatment, but the therapeutic benefits compared with naproxen and placebo were evident 3 to 4 days after the start of the treatment."	This report of above trial was for only first 5 days compared with entire 1-year trial. Patients not blinded to treatment allocation. Data suggest injection and NSAID superior to placebo for ultra-short term follow-up.
Price 1991 RCT	7.0	N = 145 with lateral epicondyliti s (pain on gripping or extensor test plus tender over lateral epicondyle or adjacent tissues); mostly chronic pain	Study 1: Injection of 2mL of 1% lignocaine alone vs. with either triamcinolone 10mg or hydrocortisone 25mg. Study 2: lignocaine plus triamcinolone 10mg vs. 20mg. 24 weeks follow-up.	Study 1: VAS pain (0/ 4/8/24 weeks): lignocaine (50/46/ 35/12) vs. hydro-cortisone (49/28/30/ 24) vs. triamcinolone (47/17/ 20/18). Pain weighted grip strength (mmHg): lignocaine (151/184/ 201/251) vs. hydrocortisone (135/ 203/200/237) vs. triamcinolone (158/ 231/238/238). Lignocaine recovered later (p <0.05). Study 2: VAS pain (0/3/8/24 weeks): 10mg (66/27/ 29/35) vs. 20mg (63/ 28/22/ 33). Pain-weighted grip-strengths 10mg (133/ 228/211/217) vs. 20mg (103/200/196/ 193) (NS).	"[M]ore rapid relief of symptoms was achieved with 10mg triamcinolone than with 25mg hydrocortisone or lignocaine alone and there was less needed to repeat injections. Results obtained with 20mg triamcinolone were similar to those of the smaller dose."	Steroid injection superior to placebo over short to intermediate term, but not long term. Data suggest triamcinolone 10mg superior to hydrocortisone 25mg.
Altay 2002 Pseudo-randomized clinical trial	4.5	N = 120 with lateral epicondyliti s (lateral elbow pain, tenderness over extensor origin, positive Mills'sign and positive chair test)	Injection of 1mL triamcinolone with 1mL lidocaine vs. injection of 2mL of lidocaine alone. Dose not provided. Used peppering injection technique of 40-50 shots with 18g needle. 12month follow-	Pain scoring system used (excellent, good, fair, or poor). Patients evaluated at 2, 6, and 12 months. No difference between groups.	"Both groups had excellent results and because the injection of local anesthetics is known to have no long-term effect in the treatment of lateral epicondylitis, the peppering technique seems to be a reliable method of treatment."	Not truly randomized (first 60). Relatively unusual injection technique of "peppering" which may have affected results. Patients well-matched for age and duration of symptoms. No complications. Results sparse. Results suggest

		Apparently most or all chronic pain	up.			both techniques equally (in)effective.
Corticosteroid Injections vs. No Treatment						
Bisset 2006, 2009 RCT	7.0	N = 198 with tennis elbow, at least 6 weeks duration	Wait and see vs. injection (triamcinolone acetonide 10mg plus 1mL 1% lidocaine) vs. physiotherapy (elbow manipulation and therapeutic exercise, 8 treatments of 30 minutes plus HEP including resistant band over 6 weeks). All received information booklet and "practical advice."	Pain-free grip ratio: at 3/6 weeks injection (compared to wait and see) favorable with 42.0 (32.6 to 51.3)/ 36.4 (26.5 to 46.3), (mean (95% CI)). At 26/52 weeks, wait and see favorable with -19.6 (-33.0 to -6.2)/ -12.1 (-23.6 to 0.3); 6 weeks, physiotherapy favorable over wait and see 20.1 (10.3 to 30.0), at 52 weeks less favorable at 4.3 (-7.5 to 16.2). Injection favored over physiotherapy at 3/6 weeks with 31.2 (22.2 to 40.2)/16.3 (6.6 to 26.0), at 26/52 weeks physiotherapy favorable with -30.1 (-43.1 to -17.2)/-16.4 (-27.9 to -4.8). Assessor severity rating: at 3/6 weeks injection favorable over wait and see at 35.9 (28.3 to 43.4)/ 29.9 (22.2 to 37.7), at 26/52 weeks wait and see favorable -17.5 (-26.2 to -8.9)/-8.3 (-15.2 to -1.3). Physiotherapy overall favorable over wait and see at 3/52 weeks 9.8 (2.3 to 17.3)/5.1 (-1.9 to 15.2). Injection at 3/6 weeks favorable over physiotherapy 26.1 (18.7 to 33.4)/ 15.0 (7.2 to 22.6), at 26/52 weeks physiotherapy favorable -25.7 (-34.4 to -17.1)/-13.3 (-20.4 to -6.3).	"Physiotherapy combining elbow manipulation and exercise has a superior benefit to wait and see in the first six weeks and to corticosteroid injections after six weeks, providing a reasonable alternative to injections in the mid to long term. The significant short term benefits of corticosteroid injection are paradoxically reversed after six weeks, with high recurrence rates, implying that this treatment should be used with caution in the management of tennis elbow."	Confounders addressed include removal of those participants who did not adhere to the protocol, assessment of non-protocol treatment, blinding (had assessor guess at end of study and conducted post-hoc analyses). Data suggest injections most successful short-term. Wait and see and physiotherapy equivalent at 1 year.
Smidt	6.5	N = 185	Wait and see	Main complaint	"The decision to treat	Large sample size.

2002 RCT		with lateral epicondylitis (pain in lateral elbow, increased pain with epicondylar pressure and resisted wrist dorsiflexion) Subacute and chronic pain	(avoid provocative activities, ergonomic advice, paracetamol) vs. injection (1 mL triamcinolone acetonide (10 mg/mL) and 1 mL lidocaine 2%; up to 3 injections) vs. physiotherapy (9 sessions of pulsed ultrasound, 2 W/cm^2 for 7.5 minute/session; deep friction massage, exercise program); 52 weeks follow-up.	improvement (3/6/12/26/52 weeks): wait and see (6±14/21±32/33±30/47±30/53±28) vs. injection (43±28/46±30/37±30/36±34/44±32) vs. physiotherapy (11±18/26±28/43±31/53±31/59±25). At 6/52 weeks success rates for injections were 92%/69%, physiotherapy 47%/91%, and wait and see 32%/83% (all NS).	with physiotherapy or to adopt a wait-and-see policy might depend on available resources, since the relative gain of physiotherapy is small."	Physiotherapy group with mixed interventions. Confounders addressed age, gender, duration of current episode, dominant elbow affected, acute onset, concomitant neck disorders, previous episodes of lateral elbow pain, putative cause, and use of analgesics during past week. Data suggest wait and see not different from physiotherapy, but trends towards physiotherapy. Data suggest injections superior in short term, then trends to be inferior.
Tonks 2007 RCT	4.0	N=48 with diagnosis of tennis elbow (pain on palpation and resisted wrist extension). Duration unclear.	No treatment vs injection only (triamcinolone 10mg plus 2% lignocaine, total 1mL to symptomatically tender area) vs physiotherapy only (Pienimaki Physiotherapy 1996), stretching and conditioning) vs combined. 7 weeks follow-up.	Patient related forearm evaluation questionnaire (PRFEQ) superior in injection group for pain (-2.88±1.80 vs. PT -0.70±1.85 vs. combined -3.31±2.81 vs. observation 0.34± 1.43), p = 0.001), PRFEQ function (p = 0.001), and overall (p = 0.001). Pain free grip strength changes from baseline (10.14± 8.64 vs. 4.96 ±12.22 vs. 8.76±6.13 vs. 1.47±7.7), NS.	"Injections alone are effective not only in terms of their pain relieving and function improving effect, but are much more time and cost efficient than physiotherapy."	Relatively small sample sizes to detect benefits between groups. Data suggest injections effective, but trends appear in data in favor of exercise over observation.
Assessment of Corticosteroid Injection Techniques						
Dogramaci 2009 RCT	6.0	N=75 with positive tennis elbow test with lateral epicondyle pain. 6mo follow-up.	Steroid injection ("triamcinolone (1mL)" n=25) vs. local anesthetic injection with peppering technique (n=25) vs. steroid injection with peppering (n=25).	No difference in VAS at 3 weeks (p=0.155). At 6-months steroid and peppering VAS scores better (p=0.002) than other 2 groups. Percent 'excellent' at 6mo steroid 36% vs. local peppering 48% vs. steroid with peppering 84%.	"[T]he local corticosteroid injection becomes more effective and lower the rate of required additional injections when combined with peppering in treating patients with lateral epicondylitis."	Randomization and patient descriptions sparse. Steroid dose not provided. Data suggest CS with peppering technique superior to injection alone or anesthetic with peppering.
Corticosteroid Injections combined with other Treatments						

Newcomer 2001 RCT	9.5	N = 39 with lateral epicondylitis (lateral elbow tenderness or extensor mass tenderness plus pain with resisted finger or wrist extensor testing) of under 4 weeks duration	Rehab program in both arms (ice massage TID-5 times a day; wrist stretching, concentric/ eccentric strengthening of wrist extensors/ flexors, 3 sets 10 reps plus betamethasone 6mg plus 4mL 0.25% bupivacaine hydrochloride vs. 5mL bupivacaine. 6 months follow-up.	Mean decrease in pain with grasp (baseline-4 weeks/8 weeks/6 months): injection (0.79/0.82/1.85) vs. placebo (0.56/1.12/1.56) (NS). Multiple other outcomes measures also NS, with sole exception of VAS pain scale between 8 weeks and 6 months favoring steroid injection (p <0.05).	"A corticosteroid injection does not provide a clinically significant improvement in the outcome of LE, and rehabilitation should be the first line of treatment in patients with a short duration of symptoms."	Injections combined with rehab program, thus multiple co-interventions. Rehab program compliance not assessed. Scoring for double-blinding with steroid vs. placebo. Confounders addressed age, gender, symptom duration. Data suggest injection not of additive benefit. Authors conclude that rehab should be 1st-line treatment not supportable with data as both received same treatment.
Corticosteroid Injections vs. Platelet-rich Plasma Injections						
Krogh 2013 RCT	9.0	N=60 with lateral epicondylitis for at least 3 mo. No injections in past 3 months. Also used ultrasound for diagnosis and following.	Triamcinolon 40mg plus lidocaine (GC) vs. Saline (NS) vs. Platelet Rich Plasma injections (from 27mL whole blood, concentrated and buffered). US-guided injections. PRP and saline peppering technique (~7 tendon injection). GC inx only at deepest aspect common tendon origin. Follow-ups at 4 weeks, 3, 6, and 12 months.	Changes in pain from baseline (PRP/NS/GC) at 1 month: -0.5/-1.7/-9.8. At 3 months: -6.0/-3.3/-7.1. Disability chnage at 1mo (PRP/NS/GC): -5.2/-3.4/-21.9. Disability at 3 months: -16.6/-7.6/-13.8. No diferences between groups in ultrasound Doppler findings, or tendo thickness.	"Neither injection of PRP nor glucocorticoid was superior to saline with regard to pain reduction in LE at the primary end point at 3 months. However, injection of glucocorticoid had a short-term pain-reducing effect at 1 month in contrast to the other therapies."	Some baseline differences, especially more chronic in GC group, presumably biases against GC efficacy. Three month endpoint after which high dropouts and intended to do 12 month study, but 12 month data compromised with the dropouts. Data suggest GC superior and only in the 4 week timeframe.
Peerbooms 2010 RCT	8.0	N = 100 with chronic lateral epicondylitis (lateral epicondyle tenderness, pain with resisted wrist extension with at least 50 on 0-100 VAS).	Platelet-rich plasma 3mL plus bupivacaine 0.5% vs. triamcinolone acetonide 40mg/mL plus bupivacaine 0.5%. Used peppering technique. All received stretching for 2	Additional injections in corticosteroid group (7) vs. platelet group (2). DASH scores (pre/0/4/8/12/26/52 weeks): glucocorticoid (131.2±58.2/97.4±69.0/84.7±73.4/92.2±68.7/ 117.3±75.6/108.4±82.2) vs. platelet-rich plasma	"Treatment of patients with chronic lateral epicondylitis with PRP reduces pain and significantly increases function, exceeding the effect of corticosteroid injection."	Blinding aspects for treating physician particularly unclear. No placebo control. Used peppering technique. Total dose of glucocorticoid somewhat unclear. Data suggest PRP superior to

		At least 6 months duration.	weeks, then strengthening. 12 months total follow-up.	(161.2±62.4/135.9±78.0/113.4±79.6/ 92.0± 78.8/79.5±80.3/54.7 ± 73.2), p = 0.005.		glucocorticosteroid injection at 1 year.
Gosens 2011 RCT (2nd Report, Peerbooms 2010)	8.0	N = 100 with lateral epicondylitis. Follow-ups at 0/4/8/12/26/ 52/104 weeks.	Platelet rich plasma injection (PRP) (n=51) vs. corticosteroid injection (CS) (n=49). All received one injection.	39 PRP patients had successful VAS scores vs. 21 in CS, (p<0.0001). At end, no differences between 2 groups for DASH but PRP favored at 26 (p= 0.037), 52 and 104 weeks (P<0.0001). 37 treated successfully in PRP vs. 19 with CS (p<0.0001).	"[A] single injection of concentrated autologous platelets improves pain and function more effectively than (CS) in chronic lateral epicondylitis. These improvements were sustained over a 2 year follow-up time with no reported complications."	Blinding unclear. Baseline higher DASH in PRP (44 v 56, p<0.001), suggests possible randomization failure. Data suggest PRP superior at 2 years.
Corticosteroid Injections vs. Autologous Blood						
Kazemi 2010 Quasi-RCT	6.5	N = 60 aged 27-64 years diagnosed with tennis elbow (duration <1 year	30 injected with methylprednisolone (20 mg plus 1 ml of 2% lidocaine) (CS) vs. 30 patients injected with 2 ml of Autologous blood (AB) plus 1 ml of 2% lidocaine with follow-ups at 4 and 8 weeks.	Pain (0/4/8weeks): AB (6.5/2.7/1.5) vs. CS (6.7/4.5/4.0), p=0.001. AB also favored for grip pain (p=0.002), pressure pain threshold (p = 0.031), and Quick DASH (p = 0.004).	"[B]ecause of the satisfactory pain relief and restoring function, we prefer AB injections as the treatment in patients with LET."	Quasi-randomized (every other). Unclear if prior corticosteroid injection exclusionary. Location of AB injection not noted. Corticosteroid injected from post. to epicondyle to ECRB undersurface. Not targeted max. tender point. Data suggest AB superior to steroid.
Ozturan 2010 RCT	4.0	N = 60 diagnosed with lateral epicondylitis for at least 6 months. Follow-ups at 4, 12, 26, 52 wks.	All groups initially prilocaine 1mL to skin and SQ. Group 1 (CS) methylprednisolone acetate (1 mL) with 5 skin penetrations at tender point (n = 20) vs. group 2 (AB) 2mL autologous blood to most painful part (n = 20) vs. group 3, US gel and 1 ESWT with 2000 imp. at 0.17 mJ/mm² once a week for 3 weeks.	At 4 weeks, CS superior functional score vs. other groups (p<0.001). At 52 weeks, AB and ESWT improved vs. CS (p<0.001). For Thomsen Provocation Test, only difference at 4 weeks and CS favored over both groups (p<0.001). For grip strength mean improvement, at 4 weeks, corticosteroid favored (p<0.05). At 26 weeks, extracorporeal shock wave therapy group made greater improvement than corticosteroid injections (p<0.05).	"[C]orticosteroid injection provided a high success rate in short term. However, (AB) injection and (ESWT) gave better long-term results, especially considering the high recurrence rate with (CS). We suggest that the treatment of choice for lateral epicondylitis be (AB) injection."	More heavy work in CS>AB>ESWT. CS dose not provided. Data suggest EWST and AB comparable, and both superior to CS.

				No other differences seen.		
Corticosteroid Injections vs. Other Treatments						
Uzunca 2007 Pseudo-randomized clinical trial	6.0 for PEMF 5.0 for Cort. Injx	N=60 with lateral elbow and forearm pain. Duration more than 6 weeks.	Pulsed electro-magnetic field (Group I magnetotherapy, BTL-09, 6mT/ session, 25Hz, 4.6Hz frequency, 30 minute sessions, 5 times a week/3 weeks.) vs. placebo (sham, Group II) vs methyl-prednisolone acetate 40mg plus prilocaine HCl 20mg/1mL (into most tender point, Group III). Follow-up "after 3 months."	Rest pain VAS (pre/post/3 months): Group I (3.43±2.56/ 1.05± 1.69/0.09±0.44) vs. Group II (3.39±2.08 / 1.95±1.75/1.79±1.93) vs. Group III (4.02± 2.05/0.50±0.69/1.40 ± 2.09). All improved. Statistical results between groups not presented.	"[P]atients treated with PEMF had lower pain levels during rest, activity, and nighttime when compared with patients treated with corticosteroid injections after 3 months, although pain during resisted wrist dorsiflexion and forearm supination maneuvers and algometric values were not different."	Pseudorandomization by sequence in clinic. Durations differed at baseline (4.1 vs. 2.4 vs. 3.4 months) concern for potential randomization failure. Blinding methods somewhat unclear. Score for PEMF vs. sham. (Score for injection 5.0). Highly intensive treatment regimen. Between group results not presented with tables of data, qualitatively described as mostly negative.
Verhaar 1996 RCT	4.5	N = 106 with tennis elbow (pain on lateral elbow, pain with resisted wrist dorsiflexion with elbow fully extended)	Corticosteroid injection (1 mL of triamcinolone acetate suspension 1% diluted with 1 mL of lidocaine 1% into tendinous origin) vs. physiotherapy (12 treatments over 4 weeks of deep transverse friction over the extensor origin and Mills' manipulations).	Physiotherapy was favorable at 0 weeks for mean grip strength (24.5 ± 13.8kg) vs. injection (18.4 ± 9.3), but at 6/52 weeks injection favored (29.1 ± 15.9)/(33.1 ± 13.5) vs. physiotherapy (25.6 ± 13.7)/(34.5 ± 14.6).	"We conclude that at six weeks, treatment with corticosteroid injections was more effective than Cyriax physiotherapy and we recommend it because of its rapid action, reduction of pain and absence of side effects."	Data suggest injection superior, however trial duration 6 weeks.
Haker 1993 RCT	4.0	N = 61 with lateral elbow pain and 2+ of: tenderness over lateral epicondyle, resisted wrist extension, passive extensor stretching, resisted finger extension. Duration at least 1	Elbow band (Epicondylitis-Clasp, group I, n = 11) vs. splint (forearm support with wrist in 30º dorsiflexion, group II, n = 19) vs. injection (triamcinolone 0.2mL of 10mg/mL plus bupivacaine HCl 0.3 ml into maximal tenderness; 2nd injection in 1	Percent excellent or good outcomes (2 weeks/3 months/6 months/12 months): Group 1 (11/50/44/38) vs. Group II (5/21/53/42) vs. Group III (68/63/28/31). Steroid superior at 2 weeks ($p < 0.001$), and NS other times. Vigorimeter test different between group I (2) and group III (28) at 2 weeks, $p < 0.05$, and between group II (3)	"[D]espite the high incidence of recurrence and the clinical side-effects reported after local steroid injection… steroid injection might be the treatment of choice in very severe cases to achieve rapid relief of pain."	Data suggest injection superior in short term. Trend towards worse results in injection at 6-12 months.

		month	week if no effect, group III, n = 19); 3 months brace and splint use; 1 year follow-up.	and group III (28), p <0.05.		
Corticosteroid Injections with Lidocaine vs. Bupivacaine						
Sölveborn 1995 RCT	5.0	N = 109 with radial epicondylalgia (history, tender to palpation on epicondyle, increased pain with resisted wrist extension)	Injections with triamcinolone 10mg plus 1mL lidocaine 5mg/mL vs. bupivacaine 2.5mg/mL. 1-year follow-up.	Overall results NS. However, bupivacaine superior to lidocaine at 2 weeks and 1 year if either no prior treatment or short duration of symptoms.	"Comparison between lidocaine (a short-acting local anesthetic) and bupivacaine (which is longer acting) as additives to a local corticosteroid injection showed no differences in effects for the entire patient group. However, when the material was subdivided, outcome at 2 weeks was significantly better with bupivacaine for patients who had not been treated previously in any way and for those with short histories of epicondylalgia, defined as symptom duration no longer than 3 months."	Results sparse. Data suggest injections with bupivacaine superior to lidocaine over intermediate to long term if no prior treatment and short duration of symptoms.
Activity after Corticosteroid Injections						
Weitoft 2010 RCT	4.0	N = 90 patients with rheumatoid arthritis and elbow synovitis (men: 18, female: 72)	Intraarticular elbow injection in all (triamcinolone hexacetonide 20mg) then Immobilization Group (n=46) with arm in sling for 48 hours post injection vs. usual Activity Group (n=44). After baseline, follow ups at 1 wk, 3 months, and 6 months post injection.	Elbow pain, function, and mobility were not different between groups.	"[B]ecause neither wrists nor elbows respond with a better outcome after postinjection rest, we conclude that patients with intraarticular glucocorticoid treatment of joints of the upper extremity should not be given advice to rest after the injection."	RA patients. Trend to more relapses in the rest group. Data suggest rest not indicated post intraarticular injection. Unclear applicability to other diagnoses especially including lateral epicondylalgia.

Dry Needling/Peppering Technique

Author Year (Score):	Category:	Study type:	Conflict of Interest:	Sample size:	Age/Sex:	Comparison:	Follow-up:	Results:	Conclusion:	Comments:
Krogh 2013 (score = 9.0)	Dry Needling	RCT	COI, one or more of the authors have received or will receive benefits for personal or professional use. Sponsored by the Danish Rheumatism Association, the Musculoskeletal Statistics Units at the Parker Institute, and the Biomet Biologics Inc.	N = 60 with lateral epicondylitis for at least 3 months. No injections in past 3 months. Also used ultrasound for diagnosis and following.	Mean age: 45.4 years; 29 males, 31 females.	Triamcinolon [sic] 40mg plus lidocaine (GC) (n=20) vs. Saline (NS) (n=20) vs. Platelet Rich Plasma injections (from 27mL whole blood, concentrated and buffered) (n=20). US-guided injections. PRP and saline peppering technique (~7tendon injx). GC injection only at deepest aspect common tendon origin.	Follow-up at 4 weeks, 3, 6, and 12 months.	Changes in pain from baseline (PRP/NS/GC) at 1 month: -0.5/-1.7/-9.8. At 3 months: -6.0/-3.3/-7.1. Disability change at 1 month (PRP/NS/GC): -5.2/-3.4/-21.9. Disability at 3 months: -16.6/-7.6/-13.8. No differences between groups in ultrasound Doppler findings, or tendon thickness.	"Neither injection of PRP nor glucocorticoid was superior to saline with regard to pain reduction in LE at the primary end point at 3 months. However, injection of glucocorticoid had a short-term pain-reducing effect at 1 month in contrast to the other therapies."	Some baseline differences, especially more chronic in GC group, presumably biases against GC efficacy. Three month endpoint after which high dropouts and intended to do 12 month study, but 12 month data compromised with the dropouts. Data suggest GC superior and only in 4 week timeframe.
Altay 2002 (score = 4.5)	Dry Needling	Pseudo-randomized clinical trial	No mention of COI or sponsorship.	N = 120 with lateral epicondylitis (lateral elbow pain, tenderness over extensor origin, positive Mills'sign and positive chair test). Apparently most or all chronic pain	Mean age: 43.75 years; no mention of sex distribution.	Injection of 1mL triamcinolone with 1mL lidocaine (n=60) vs. injection of 2mL of lidocaine alone. Dose not provided. (n=60) Used peppering injection technique of 40-50 shots with 18g needle.	Follow-up at 12 months.	Pain scoring system used (excellent, good, fair, or poor). Patients evaluated at 2, 6, and 12 months. No difference between groups.	"Both groups had excellent results and because the injection of local anesthetics is known to have no long-term effect in the treatment of lateral epicondylitis, the peppering technique seems to be a reliable method of treatment."	Not truly randomized (first 60). Technique of "peppering" yet no control for peppering technique. Patients well-matched for age and duration of symptoms. No complications. Results sparse. Results suggest both techniques equally (in)effective.

Dogramaci 2009 (score = 6.0)	Dry Needling	RCT	No mention of sponsorship or COI.	N = 75 with positive tennis elbow test with lateral epicondyle pain.	Mean age: 46.35 years; 32 males, 43 females	Steroid injection ("triamcinolone (1mL)" n=25) vs. local anesthetic injection with peppering technique (n=25) vs. steroid injection with peppering (n=25).	Follow-up at 6 months.	No difference in VAS at 3 weeks (p=0.155). At 6-months steroid and peppering VAS scores better (p=0.002) than other 2 groups. Percent 'excellent' at 6mo steroid 36% vs. local peppering 48% vs. steroid with peppering 84%.	"[T]he local corticosteroid injection becomes more effective and lower the rate of required additional injections when combined with peppering in treating patients with lateral epicondylitis."	Randomization and patient descriptions sparse. Steroid dose not provided. Data suggest CS with peppering technique superior to injection alone or anesthetic with peppering.
Stenhouse 2013 (score=3.5)	Dry Needling	RCT	No mention of sponsorship. No COI.	N = 28 patients with refractory lateral epicondylitis who underwent dry needling	Mean age: 49.1 years; 11 males, 17 females	Dry Needling Group: received dry needling (23G needle passing in and out long axis of tendon without exiting skin 40-50 times) alone for 2 min (n=13) vs ACP Group: received dry needling for 2 min and then received autologous conditioned plasma injection of 2 mL (n=15)	Follow-up at 1, 2, and 6 months.	Mean improvement in VAS was 0.85 (95% CI 1.13-2.83) in dry needling group compared to 2.19 (95% CI 0.85-3.53) in ACP group at 2 months. Mean improvement in VAS at 6 months was 2.37 (95% CI 0.27-4.47) in dry needling compared to 3.92 (95% CI 2.11-5.72) in the ACP group. Nirschl scores improved by 22.5 points (95% CI 6.4-38.6) in dry needling group compared to 40.0 points (95% CI 27.5-52.6) in the ACP group.	"There is a trend towards greater clinical improvement in short term for patients treated with additional ACP, however no significant difference between the two treatment groups was demonstrated at each follow-up interval."	Pilot study. Small sample. Baseline differences in duration and Nirschl scores (22.9 vs. 11.1). 6 month follow-up evaluation data suggest a trend towards short term clinical improvement in ACP group.
Uygur 2017 (score=2.5)	Dry Needling	RCT	No mention of sponsorship or COI.	N = 92 with lateral epicondylitis. Chronicity unstated. Patients not described well	Mean age: 47.83 years; 20 males; 72 females	Dry needling (n=51) vs IBU 100mg BID plus elbow strap (n=41).	Follow-up at 3 weeks and 6 months.	Significant difference in PRTEE (pain and function) scores at 3 weeks in both groups ($p < 0.05$). At six months, dry needling produced lower mean PRTEE	"Because of the low complication rate, dry needling is safe method, and it might be an effective treatment option for LE."	Sparse methods. Subtherapeutic IBU in control group (100mg BID). No baseline demographic data by groups. Duration not

								scores compared to IBU (p < 0.01).		reported. Follow-ups at 3 weeks and 6 months. Data suggest at 6 months the dry needling was more effective. Possible usual care bias as control had IBU plus brace.

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Botulinum Toxin A vs. Placebo						
Placzek 2007 RCT	8.5	N = 132 with radial epicondylitis; ≥3 different conservative therapy measures tried without success; total score of 4 points on standardized examination. Duration >4 months.	Injection of botulinum toxin A (Dysport 60 mouse units plus 0.6mL NS) vs. placebo (0.6 mL NS); 18 weeks follow-up.	Mean±SD VAS score for continuous pain comparing botulinum vs. placebo: Week 6: 2.93± 0.26 vs. 4.07±0.32; p = 0.010. Week 18: 1.82± 0.26 vs. 2.68±0.31; p = 0.035. Maximum pain scores not different. Middle finger extension strength worse in botulinum group at 2, 6 weeks. Wrist strengths not different.	"We concluded that local injection of botulinum toxin A is a beneficial treatment for radial epicondylitis (tennis elbow). The treatment can be performed in an outpatient setting and does not impair the patient's ability to work."	Improved pain scores over 18 weeks. No differences in maximum pain scores. No longer term follow-up.
Espandar 2010 RCT	8.5	N = 48 aged 18-70 with chronic lateral epicondylitis	Injection of botulinum toxin A 60 units in 1 ml NS (n=24) vs. 1 ml NS (n=24). Injections 1/3 of way from olecranon to radial styloid. Follow-up 0, 4, 8, and 16 weeks.	Pain score at rest, mm (baseline/week 4/week 8/ week 16): botulinum toxin (48.8±23.7/20.4±15.9/17.9±18.0/3.9±6.0) vs. placebo (46.4±16.2/34.5±12.2/29.4±14.5/16.7±10.5), p=0.010. Pain score during maximum grip, mm (baseline/week 4/week 8/week 16): (65.8±22.0/52.0±23.3/43.8±23.1/18.8±10.0) vs. (65.0±18.3/57.4±18.2/51.5±20.1/30.6±15.6), p=0.22. Maximum grip strength, kg: (17.4±5.2/14.5±4.5/13.1±4.4/17.1±5.4) vs. (18.8±5.0/19.0±4.6/18.4±4.8/18.8±4.8), p=0.02.	"The use of precise anatomic measurement to guide injection of botulinum toxin significantly reduced pain at rest in patients with chronic refractory lateral epicondylitis."	Data suggest botulinum superior to NS for short term, but problems with weakness noted. Conclusion regarding anatomic measurement does not follow from the design as no randomization of injection location.
Wong 2005 RCT	8.0	N = 60 with tennis elbow, >18 years old, lateral elbow pain, lateral epicondylar pain with resisted	60 U botulinum toxin (Dysport) vs. normal saline (deep subcutaneous tissue and muscle, 1cm from lateral epicondyle, toward tender spot). 12 weeks follow-up.	Mean±SD pain intensity (mm) comparing botulinum vs. placebo: Week 4: 25.3±18.8 vs. 50.5±21.7; p <0.001. Week 12: 23.5±22.3 vs. 43.5±23.9; p = 0.006. Grip strengths not different, although	"Botulinum toxin injection may improve pain over a 3-month period in some patients with lateral epicondylitis, but injections may be associated with digit paresis and weakness of finger	No longer term follow-up. Shorter mean symptoms duration in botulinum at baseline (11.8 vs. 19.1mo) may bias in favor of

		dorsiflexion ; >3 months duration.		decreased at 4weeks in botulinum group (20.3 to 17.5).	extension."	botulinum. Adverse effects with injection.
Hayton 2005 RCT	8.0	N = 40 with tennis elbow. All at least 1 cortico-steroid injection and physio-therapy; duration >6months.	Botulinum toxin type A 50U vs. normal saline. 3months follow-up.	At 3 months, no differences in grip strength of quality of life. VAS pain scores (pre/post): botulinum (8.80/11.35) vs placebo (9.43/12.46), NS.	"With the numbers studied, we failed to find a significant difference between the two groups; thus, we have no evidence of a benefit from botulinum toxin injection in the treatment of chronic tennis elbow."	No long term follow-up. No differences in outcomes. Data suggest no meaningful benefits.
Lin 2010 RCT	5.5	N=16 patients (19 elbows) with spontaneous lateral epicondyle pain, local tenderness, and pain aggravated by resisted MF or wrist extension	Botulinum toxin type A 50U plus 1ml NS (Botox group, n=8) vs. triamcinolone acetonide 40mg (n=9). Injection into ECRB near origin of wrist/finger extensors. Follow-up at 4, 8, and 12 weeks.	Change in VAS score at 4 weeks: botox -5.9±28.4 vs. steroid -31.8±22.1, p=0.02. Change in grip strength (kg) from at 4 weeks: -7.5±5.5 vs. 1.9±6.8, p=0.01. Grip strength at 8 weeks: -5.7±4.8 vs. 0.9±5.3, p=0.03. Grip strength at 12 weeks: -3.4±5.2 vs. 0.7±5.5, p=0.06. VAS at 8 and 12 weeks: NS. WHO scores: not significant throughout study.	"Corticosteroid is superior to botulinum toxin type A in relieving pain in tennis elbow at 4 weeks after injection. Because botulinum toxin injection did not relieve pain significantly but is associated with weakness, the muscle weakness caused by botulinum toxin is unlikely to be the sole mechanism of the pain relief observed in previous studies."	Small sample size. CS superior for VAS at 4 weeks and grip strength at 4, 8 weeks and borderline at 12 wks (p=0.06).

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Platelet-rich Plasma Injections						
Krogh 2013 RCT	9.0	N = 60 with lateral epicondylitis for at least 3 months. No injections in past 3 months. Also used ultrasound for diagnosis and following.	Triamcinolon 40mg plus lidocaine (GC) vs. Saline (NS) vs. Platelet Rich Plasma injections (from 27mL whole blood, concentrated and buffered). US-guided injections. PRP and saline peppering technique (~7tendon injx). GC inx only at deepest aspect common	Changes in pain from baseline (PRP/NS/GC) at 1 month: -0.5/-1.7/-9.8. At 3 months: -6.0/-3.3/-7.1. Disability chnage at 1mo (PRP/NS/GC): -5.2/-3.4/-21.9. Disability at 3 months: -16.6/-7.6/-13.8. No diferences between groups in ultrasound Doppler findings, or tendo thickness.	"Neither injection of PRP nor glucocorticoid was superior to saline with regard to pain reduction in LE at the primary end point at 3 months. However, injection of glucocorticoid had a short-term pain-reducing effect at 1 month in contrast to the other therapies."	Some baseline differences, especially more chronic in GC group, presumably biases against GC efficacy. Three month endpoint after which high dropouts and intended to do 12 month study, but 12 month data compromised with the dropouts. Data suggest GC superior and only in the 4 week timeframe.

			tendon origin. Follow-ups at 4 weeks, 3, 6, and 12 months.			
Peerbooms 2010 RCT	8.0	N = 100 with chronic lateral epicondylitis (lateral epicondyle tenderness, pain with resisted wrist extension with at least 50 on 0-100 VAS). At least 6 months duration.	Platelet-rich plasma 3mL plus bupivacaine 0.5% vs. triamcinolone acetonide 40mg/mL plus bupivacaine 0.5%. Used peppering technique. All received stretching for 2 weeks, then strengthening. 12 months total follow-up.	Additional injections in corticosteroid group (7) vs. platelet group (2). DASH scores (pre/0/4/8/12/26/52 weeks): glucocorticoid (131.2±58.2/97.4±69.0/84.7±73.4/92.2±68.7/ 117.3±75.6/108.4±82.2) vs. platelet-rich plasma (161.2±62.4/135.9±78.0/113.4±79.6/ 92.0± 78.8/79.5±80.3/54.7±73.2), p = 0.005.	"Treatment of patients with chronic lateral epicondylitis with PRP reduces pain and significantly increases function, exceeding the effect of corticosteroid injection."	Blinding aspects for treating physician particularly unclear. No placebo control. Used peppering technique. Total dose of glucocorticoid somewhat unclear. Data suggest PRP superior to glucocorticosteroid injection at 1 year.
Gosens 2011 RCT (2nd Report, Peerbooms 2010)	8.0	N=100 with lateral epicondylitis. Follow-up at 0/4/8/12/26/52/104 weeks.	51 with platelet rich plasma injection (PRP) vs. 49 corticosteroid injection (CS). All received one injection.	39 PRP patients had successful VAS scores vs. 21 in CS, (p<0.0001). At end, no differences between 2 groups for DASH but PRP favored at 26 (p= 0.037), 52 and 104 weeks (P<0.0001). 37 treated successfully in PRP vs. 19 with CS (p<0.0001).	"[A] single injection of concentrated autologous platelets improves pain and function more effectively than (CS) in chronic lateral epicondylitis. These improvements were sustained over a 2 year follow-up time with no reported complications."	Blinding unclear. Baseline higher DASH in PRP (44 v 56, p<0.001), suggests possible randomization failure. Data suggest PRP superior at 2 years.
Thanasas 2011 RCT	7.0	N=28 patients with chronic lateral epicondylitis (i.e., duration of symptoms 3 months).	Group A: Single injection of 3 mL of autologous blood vs. Group B: 3 mL of PRP under ultrasound guidance. 1 week after injection, eccentric loading exercises were performed twice a day for 5 weeks. Re-evaluation done at 6 weeks, 3 and 6 months.	At 6 weeks, mean improvement was 3.8 points (95% CI, 3.1-4.5) in group B (61.47% improvement) and 2.5 points (95% CI, 1.9-3.1) in group A (41.6% improvement; p<0.05).	"Regarding pain reduction, PRP treatment seems to be an effective treatment for chronic lateral elbow epicondylitis and superior to autologous blood in the short term. Defining details of indications, best PRP concentration, number and time of injections, as well as rehabilitation protocol might increase the method's effectiveness. Additionally, the possibility of cost reduction of the	Six month follow-up. All treated with exercise. Peppering technique used. Data suggested modest superiority of PRP over AB at 3 and 6 months.

					method might justify the use of PRP over autologous whole blood for chronic or refractory tennis elbow.”	
Creaney 2011 RCT	6.0	N = 150 diagnosed with lateral epicondylitis not responsive to conservative treatments. Follow-ups at 0/1/3/6 months.	80 in platelet rich plasma injection group (PRP) with blood spun at 2000g for 15 min. and 1.5 ml siphoned from buffy coat and 70 in autologous blood injection group (ABI). Injections at 0/1 months.	PRP group had a success rate of 66% (95% CI 55% to 77%) v. 72% (95% CI 61% to 83%) in the blood group, p = 0.59.	“[P]atients who are resistant to first-line physical therapy such as eccentric loading, ABI or PRP injections are useful second-line therapies to improve clinical outcomes. In this study, up to 7 out of 10 additional patients in this difficult to treat cohort benefit from a surgery-sparing intervention.”	Blinding not well described. Many details sparse. Patients not well described. Data suggest comparable results, consistent with equal efficacy (or inefficacy).
Autologous Blood Injections						
Kazemi 2010 Quasi-RCT	6.5	N = 60 aged 27-64 years diagnosed with tennis elbow. Duration <1year.	30 injected with methylprednisolone (20 mg plus 1 ml of 2% lidocaine) (CS) vs. 30 patients injected with 2 ml of Autologous blood (AB) plus 1 ml of 2% lidocaine with follow-ups at 4 and 8 weeks.	Pain (0/4/8wks): AB (6.5/2.7/1.5) vs. CS (6.7/4.5/4.0), p = 0.001. AB also favored for grip pain (p = 0.002), pressure pain threshold (p = 0.031), and Quick DASH (p = 0.004).	“[B]ecause of the satisfactory pain relief and restoring function, we prefer AB injections as the treatment in patients with LET.”	Quasi-randomized (every other). Unclear if prior corticosteroid injection exclusionary. Location of AB injection not noted. Corticosteroid injected from post. to epicondyle to ECRB undersurface. Not targeted max. tender point. Data suggest AB superior to steroid.
Ozturan 2010 RCT	4.0	N = 60 diagnosed with lateral epicondylitis for at least 6 months. Follow-ups at 4, 12, 26, 52 weeks.	All groups initially prilocaine 1mL to skin and SQ. Group 1 (CS) methylprednisolone acetate (1 mL) with 5 skin penetrations at tender point (n = 20) vs. group 2 (AB) 2mL autologous blood to most painful part (n=20) vs. group 3, US gel and 1 ESWT with 2000 imp. at	At 4 weeks, CS superior functional score vs. other groups (p<0.001). At 52 weeks, AB and ESWT improved vs. CS (p<0.001). For Thomsen Provocation Test, only difference at 4 weeks and CS favored over both groups (p<0.001). For grip strength mean improvement, at 4 week, corticosteroid was favored (p<0.05). At 26 weeks, extracorporeal shock wave therapy group made greater improvement than	“[C]orticosteroid injection provided a high success rate in short term. However, (AB) injection and (ESWT) gave better long-term results, especially considering the high recurrence rate with (CS). We suggest that the treatment of choice for lateral epicondylitis be (AB) injection.”	More heavy work in CS>AB>ESWT. CS dose not provided. Data suggest EWST and AB comparable, and both superior to CS.

			0.17 mJ/mm² once a week for 3 weeks.	corticosteroid injections (p<0.05). No other differences seen.		
Thanasas 2011 RCT	7.0	N = 28 with chronic lateral epicondylitis (i.e., duration of symptoms 3 months).	Group A: Single injection of 3 mL of autologous blood vs. Group B: 3 mL of PRP under ultrasound guidance. 1 week after injection, eccentric loading exercises were performed twice a day for 5 weeks. Reevaluation done at 6 weeks, 3 and 6 months.	At 6 weeks, mean improvement was 3.8 points (95% CI, 3.1-4.5) in group B (61.47% improvement) and 2.5 points (95% CI, 1.9-3.1) in group A (41.6% improvement; p<0.05).	"Regarding pain reduction, PRP treatment seems to be an effective treatment for chronic lateral elbow epicondylitis and superior to autologous blood in the short term. Defining details of indications, best PRP concentration, number and time of injections, as well as rehabilitation protocol might increase the method's effectiveness. Additionally, the possibility of cost reduction of the method might justify the use of PRP over autologous whole blood for chronic or refractory tennis elbow."	Six month follow-up. All treated with exercise. Peppering technique used. Data suggested modest superiority of PRP over AB at 3 and 6 months.

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Zeisig 2008 RCT with partial crossover	7.5	N = 32 (36 elbows) with tennis elbow (lateral epicondyle tenderness, pain with forced wrist extension [sic?]). At least 3 months (mean 21 months) duration.	Polidocanol (10mg/mL) vs lidocaine HCl (10mg/mL) plus epinephrine (5µg/mL) injection. 0.5mL injected. Ultrasound and Doppler-guided injections. 3 months blind followup, 12 months total follow-up.	At 3-month follow-up, no differences in satisfaction (polidocanol 9/18(50%) vs. 10/16 (62.5%), p = 0.51 or VAS (pre/3 months) (polidocanol 68/59 vs. placebo 70/54). No differences in pain during grip (p = 0.49), and grip strength (p = 0.86). At 12-months, no differences between groups (p = 1.0, p = 0.66, p = 0.11).	"[I]njection of the sclerosing substance polidocanol or the local anesthetic lidocaine plus epinephrine gave pain relief in 50-62% of patients with tennis elbow."	Data suggest polidocanol ineffective.

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

Author/Year Study Type	Score (0-11)	Sample Size	Comparison Group	Results	Conclusion	Comments
Periarticular Viscosupplementation Injections vs. Placebo						

Akermark 1995 RCT	6.5	N = 65 diagnosed with lateral epicondylosis ≥3 months in Sweden	1 ml glycosaminoglycan polysulfate injection (GAGPS) vs. saline placebo injection. Injections given once a week for 5 weeks. Final follow-up at 26 weeks.	Significant difference in VAS between groups at week 6 and 12: p = 0.0053, p = 0.021. Significant difference in number of subjects classified as treatment failures at week 6, p = 0.011. Significant difference for pain at restricted extension at week 3 and 12: p = 0.012, p = 0.032.	"[G]AGPS injection therapy has a good pain relieving effect in chronic lateral epicondylalgia, although fairly often causing some transient local pain at injection site."	Blinding not well described. Study fairly invasive with 5 injections. Inexplicable difference in efficacy between 2 centers.
Petrella 2010 RCT	6.0	N = 331 raquette sport athletes with chronic lateral epicondylosis >3 months	1.2 cc HA injection (1% sodium hyaluronate, n=165) vs. 1.2 cc saline placebo injection (n=166). Two injections were given at random at baseline, and day 7. Final follow up was at 356 days.	HA vs. placebo mean±SD for VAS rest (cm), VAS grip (cm), patients global satisfaction using 5 pt. scale, grip (PSI), patient assessment of normal function using 5 pt. scale, and physicians global assessment using 5 pt. scale at days 30: 2.2±1.2/7.1±1.3/p<0.05, 2.0±1.5/9.9±1.5/p<0.05, 4.6±1.4/1.6±2.2/p<0.05, 68.0±2.1/45.5±1.1/p<0.05, 4.4±0.2/2.6±0.4/p<0.05, 4.3±1.1/1.8±2.2/p<0.05. Day 90: 2.5±1.4/6.7±1.5/p<0.05, 2.2±1.8/9.3±1.4/p<0.05, 4.8±0.6/1.9±0.3/p<0.05, 67.7±3.0/48.1±2.3/p<0.05, 4.8±0.1/1.3±0.7/p<0.05, 4.6±1.1/2.0±1.7/p<0.05. Day 356: 2.4±1.4/7.7±1.3/p<0.05, 2.9±1.4/9.1±1.1/p<0.05, 4.8±0.9/1.1±1.8/p<0.05, 65.7±1.8/45.6±1.3/p<0.05, 4.6±0.3/0.9±1.9/p<0.05, 4.7±0.5/1.3±0.7/p<0.05.	"Peri-articular HA treatment for tennis elbow was significantly better than control in improving pain at rest and after maximal grip testing."	Attempted blind; however viscosity different. Data suggest efficacy.

Evidence for Use of Other Injections

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Scarpone 2008 Pilot study	6.0	N = 24 with refractory lateral epicondylosis (failed relative rest,	Prolotherapy injections (1 part 5% sodium morrhuate, 1.5 parts 50%	Pain (baseline/8/16 weeks): prolotherapy (5.1±0.8/3.3±0.9/0.5±0.4) vs. control (4.5±1.7/3.6±1.2/ 3.5±1.5), p <0.001 at 16	"Prolotherapy with dextrose and sodium morrhuate was well tolerated, effectively decreased elbow	Pilot study. Plausibility of blinding in doubt as saline control vs. combination anesthetic (which

		PT, NSAIDs, 2 corti-costeroid injections). At least 6 months duration.	dextrose, 0.5 parts 4% lidocaine, 0.5 parts 0.5% sensorcaine, 3.5 parts normal saline) vs. saline. Three 0.5mL injections into supracondylar ridge, lateral epicondyle and annular ligament at 0, 4, 8 weeks; 1 year follow-up.	weeks. Grip strengths (2nd): prolotherapy (37.6±20.1/59.3±27.5/70.0±26.3) vs. control (49.0±22.6/79.8±38.6/80.0±39.5), NS. At 1 year, 60% prolotherapy vs. 10% controls had no pain or impact on ADLs.	pain and improved strength testings in subjects with refractory lateral epicondylosis compared to Control injections."	would tend to unblind) and irritating substance. Durations differed at baseline (1.1 vs. 2.7 years), potentially biasing against control group. Study requires repeating with quality methods. Data conflict. Pain ratings at 16 weeks suggest efficacy, but grip strength does not.

Evidence for the Use of Surgical Interventions for Epicondylalgia

There are 6 moderate-quality RCTs incorporated into this analysis.

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Comparison of Surgeries						
Dunkow 2004 RCT	6.5	N = 45 (47 elbows) with tennis elbow. Had failed 2 injections, modification of activity. Duration at least 12 months.	Open Nirschl release vs. percutaneous tenotomy (divide common extensor origin). All treated with same postoperative physiotherapy program. Minimum 12 months follow-up.	Patients very pleased with results in percutaneous 14/23 (60.9%) vs. open 6/24 (25%), p = 0.012. Median time to return to work: percutaneous 2 weeks (range 2-3) vs. open 5 weeks (range 4-6), p = 0.0001. Median DASH basic scores (pre/post) percutaneous (70/49) vs. open (70/53).	"The percutaneous procedure is a quicker and simpler procedure to undertake and produces significantly better results."	Data suggest results superior in percutaneous group. Superior outcomes include earlier return to work.
Khashaba 2001 RCT	6.0	N = 18 patients with 23 tennis elbows (failed injections).	Nirschl release with vs. without drilling; 6 months follow-up.	Mean improvement in VAS pain 4.6cm drilled vs. 6.8cm not drilled. Mean power improvement in drilled 5.2kg vs. 6.5kg not drilled.	"This randomized double blind comparative prospective trial shows that drilling confers no benefit and actually causes more pain, stiffness, and wound bleeding than not drilling."	Limited results reported. Data suggest drilling ineffective.
Leppilahti 2001 RCT	4.0	N = 26 patients (28 elbows) with tennis elbow. Prior treatments with physio-therapy, injections, splint/fore	Decompression of posterior interosseous nerve (at the arcade of Frohse, supinator) vs. lengthening of ECRB tendon (z-shaped	No complications. Re-operations of "4 poor elbows" in PIN vs. 3 in ECRB. Lateral elbow pain provoked with activity present in PIN 11/14 (78.6%) vs. ECRB 12/14 (85.7%). Mean grip	"The present results seem to indicate that PIN neurolysis and lengthening of the tendon of the ECRB muscle are of similar value in the surgical treatment of resistant tennis elbow. Neither of these methods, however,	Data suggest comparable (in)efficacy. Neither results strong.

		arm support band. Minimum 5 months duration.	tenotomy, then sutured). Follow-up of mean 31 months, minimum 22 months.	strengths 0.5 vs. 0.47 KP/cm^2. Excellent or good results in PIN 7/14 (50%) vs. ECRB 6/14 (42.9%).	can be considered a very effective treatment in chronic tennis elbow."	
Surgeries vs. Other Treatment						
Radwan 2008 RCT	6.0	N = 56 with lateral epicondylitis (pain induced with palpation, resisted wrist extension, chair test) with failure of conservative treatment (NSAIDs, cortico-steroid injections, physical therapy, exercise, brace). Duration at least 6 months.	Extracorporeal shock wave (1500 shocks at 18kV, 0.22mJ/mm^2) vs. percutaneous release of extensor origin; 12 months follow-up.	At 12 weeks, at least 50% improvement in Thomsen score in ESWT 21/29 (72.4%) vs. tenotomy 23/27 (85.2%). At 12 months, at least 80% improvement in Thomsen score in ESWT 14/29 (48.3%) vs. tenotomy 17/27 (63.0%). No differences in night pain, rest pain, pressure, Thomsen test, Chair test, grip at any time period.	"ESWT appears to be a useful noninvasive treatment method that reduces the necessity for surgical procedures."	Data suggest equal efficacy. May be underpowered for Thomsen scores.
Keizer 2002 RCT	5.0	N = 40 with tennis elbow (lateral elbow pain, pain with resisted wrist dorsiflexion, pain, not responsive to conservative treatment over 6 months duration.	Botulinum injection 30-40 U into ECRB (second injection if did not develop sufficient paresis, n=8) vs. wrist extensor release (Hohmann operation). 24 months follow-up.	Good results at one year in botulinum 13/20 (65%) vs. surgery 15/20 (75%). At 2 years, 4 botulinum patients had undergone surgery. Excellent or good results in 75% botulinum vs. 85% surgery.	"Botulinum toxin infiltration…may be an alternative for surgical treatment of tennis elbow."	4 (20%) of botulinum eventually crossed over to surgery. Statistically negative results between groups, although trends in favor of surgery for overall results and pain with resisted wrist or MF extension.
Microtenotomy						
Meknas 2008 RCT	4.0	N = 24 with lateral epicondyle tendinosis (lateral elbow pain plus pain with resisted wrist and digit extension), minimum duration 12 months of conservative treatment	Extensor release and repair (Nirschl JBJS 1979) vs radiofrequency microtenotomy (Tolpaz Microdebrider electrode); 18 month follow-up.	VAS pain scores (pre/3/6/12 weeks/ 10-18 months): Extensor release (6.5/6.4/4.0/3.1/2.0) vs. microtenotomy (7.1/3.6/3.2/2.0/1.8). No difference in return to work (Extensor release 11.5±6.3 vs. micro-tenotomy 10.7±2.5 weeks, NS). Grip strength improved faster in micro-	"[S]imilar results were found with 2 operative methods for patients with lateral elbow tendinosis. In the group treated with RF microtenotomy, an earlier improvement in VAS scores was seen when compared with the release method."	Randomization by share lot on day of operation. Data suggest faster improvement with microtenotomy.

		(NSAIDs, physiotherapy and at least 3 corticosteroid injections with demonstrated short-term benefit).		tenotomy (pre/12 weeks): extensor release (30.3/36.3kg) vs. microtenotomy (28.3/39.8), but not different between groups.		

Evidence for Medial Epicondylalgia

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Iontophoresis						
Nirschl 2003 RCT	7.5	N = 199 with medial or lateral epi-condylitis under 3 months duration. Diagnostic criteria not described.	Iontophoresis with 2.5ml dexamethasone sodium phosphate 0.4% injection vs. 2.5 ml saline solution. Both treatments at 40 mA-minutes, 6 treatments over 15 days; 1-month follow-up.	Dexamethasone favored over placebo group VAS pain improvement at 1 month (23 vs. 14, p = 0.012) and percentage global evaluation by investigator moderate or better (52 vs. 33, p = 0.013). Investigators' pain evaluation score (p = 0.019) and investigators' tenderness score (p <0.001) also favored iontophoresis with dexamethasone. Number of patients with improvement in all 3 primary efficacy variables significantly favored dexamethasone (p = 0.039).	"Iontophoresis treatment was well tolerated by most patients and was effective in reducing symptoms of epicondylitis at short-term follow-up."	Confounders addressed gender, age, symptom duration, prior treatments, and prior medications. Unknown how many patients had medial epicondylitis, but assume relatively few and no stratified analyses. Free to use other treatment modalities after 2-day follow-up visit. Patients who completed all 6 treatments in 10 days or less showed better results than those completing over longer period. Data suggest modest efficacy of iontophoresis with dexamethasone.
Glucocorticosteroid Injections						
Stahl 1997 RCT	8.5	N = 60 with medial epicondylitis (medial epicondylar pain, worse with work or sports, tenderness over	Injections of methylprednisolone 40mg (1mL) plus 1mL of 1% lidocaine vs. 1mL of 1% lidocaine plus 1mL saline. All treated with NSAIDs, eliminate aggravating activities and physical therapy.	Pain scores (pre/6 weeks/3 months/1 year): steroid (2.4±0.15/1.2±0.21/1.2±0.19/0.5±0.14) vs. placebo (2.3±0.15/1.9±0.19/1.3±0.19/0.6±0.22), p <0.03 only at 6 weeks.	"We believe that the improvement observed in both groups primarily reflects the natural history of the disorder, and we conclude that the local injection of steroids provides only short-term	Randomization appeared successful. There were no significant differences between groups for gender, age, duration of symptoms, pain phase at baseline, or number of dominant limbs

		flexor-pronator muscle mass, tenderness over medial epicondyle, increased pain with pronation of forearm and flexion of wrist against resist-ance). Mean durations 4 months.	12 months follow-up.		benefits in the treatment of medial epicondylitis."	affected. Study enrolled and conducted over several years. No power/sample size calculated. Data suggest efficacy in short but not long term.

Evidence for the Use of NSAIDs for Olecranon Bursitis

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

Author/Year Study Type	Score	Population	Comparison Group	Results	Conclusion	Comments
Smith 1989 RCT	4.5	N = 42 males with nontraumatic and traumatic olecranon bursitis; 6 month follow-up.	All wore compression dressing around elbow and randomized into methylprednisolone acetate 20mg intrabursal injection plus naproxen 500mg BIDx10days (n = 11) vs. methylprednisolone acetate plus placebo (n = 10) vs. naproxen BID (n = 10) vs. oral placebo (n = 10) for 10 days.	No differences between groups for bursal fluid (p>0.05). Groups treated with methylprednisolone acetate had reduced swelling after the first week and sustained improvement at 3 weeks vs. other groups (p=0.004).	"Intrabursal steroid injection seems to be superior to other modalities in controlling fluid accumulation from traumatic or idiopathic cases of nonseptic olecranon bursitis."	Most idiopathic (25), 16 traumatic, 1 gout. Some baseline differences. Cointerventions not well described. Data suggest injection superior. Injection plus NSAID trended towards best. NSAID vs. placebo negative. Underpowered for complications such as infection.

Evidence for the Use of Aspiration

There is 1 low-quality RCT in Appendix 2.(384) (Weinstein 84)

Evidence for the Use of Glucocorticosteroid Injections for Olecranon Bursitis

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

Author/Year	Score	Population	Comparison Group	Results	Conclusion	Comments

Study Type						
Smith 1989 RCT	4.5	N = 42 males with nontraumatic and traumatic olecranon bursitis; 6 month follow-up.	All wore compression dressing around elbow and randomized into methylprednisolone acetate 20mg intrabursal injection plus naproxen 500mg BIDx10days (n = 11) vs. methylprednisolone acetate plus placebo (n = 10) vs. naproxen BID (n = 10) vs. oral placebo (n = 10) for 10 days.	No differences between groups for bursal fluid (p>0.05). Groups treated with methylprednisolone acetate had reduced swelling after the first week and sustained improvement at 3 weeks vs. other groups (p = 0.004).	"Intrabursal steroid injection seems to be superior to other modalities in controlling fluid accumulation from traumatic or idiopathic cases of nonseptic olecranon bursitis."	Most idiopathic (25), 16 traumatic, 1 gout. Some baseline differences. Cointerventions not well described. Data suggest injection superior. Injection plus NSAID trended towards best. NSAID vs. placebo negative. Underpowered for complications such as infection.

Evidence for the Use of Immobilization for Elbow Fractures
There are no quality studies evaluating the use of immobilization for elbow fractures. There is 1 low-quality RCT(401) in Appendix 2.

Evidence for the Use of Opioids for Elbow Fractures
There are no quality studies evaluating the use of opioids for patients with pain from elbow fractures.

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Helling 2006 RCT	5.0	N = 165 with simple but displaced radial head fractures or multifragment radial head fractures with or without depression.	Open reduction of fractures, then fixed with 2.0 mm diameter polylactide pins with original length of 35 mm (polylactide, n = 83) vs. countersunk metal lag screws (control, n =-82). Post-op treatment with physiotherapy for up to 6 weeks. Follow up at 4-6 weeks, 1 year, and 2 years post-op.	Broberg and Morrey Elbow Scores at 2 year follow-up: polylactide (93.3±7.2) vs. control (90.9±7.5), p=0.175. Good or excellent results in 96% vs. 92% (NS).	"[P]olylactide pins can be recommended as reliable implants for the internal fixation of small, intraarticular, non-weight-bearing fractures such as displaced radial head fractures."	Data suggest comparable results at 2 years.

Evidence for the Use of NSAIDs and Acetaminophen for Elbow Dislocation

There are no quality studies evaluating the use of NSAIDs and acetaminophen for elbow dislocation.

Evidence for the Use of Opioids for Elbow Dislocation
There are no quality studies evaluating the use of opioids for elbow dislocation.
Evidence for the Use of Opioid Anesthetic Intraarticular Injections
There are no quality studies evaluating the use of opioid anesthetic intraarticular injections for pre- or post-reduction pain.

Evidence for the Use of Opioid Anesthetic Intraarticular Injections
There are no quality studies evaluating the use of opioid anesthetic intraarticular injections for pre- or post-reduction pain.

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Surgical vs. Non-surgical treatment						
Josefsson 1987 RCT	5.0	N = 30 with acute elbow dislocation	Surgical treatment (exploration, suture, re-fix ligaments) vs. non-surgical treatment (immobilized 17 days). Mean 31 and 24 month follow-ups.	No differences in ranges of motion, grip strength, pain, instability. No differences in loss of flexion. No recurrent dislocations in either group.	"Iontophoresis treatment was well tolerated by most patients and was effective in reducing symptoms of epicondylitis at short-term follow-up."	Data suggest no advantage to surgical treatment.

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

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

Evidence for the Use of NSAIDs and Acetaminophen for Biceps Tendinosis and Tears
There are no quality studies evaluating the use of NSAIDs and acetaminophen for biceps tendinosis and tears.

Evidence for the Use of Opioids for Biceps Tendinosis
There are no quality studies evaluating the use of opioids for patients with biceps tendinosis or ruptures.

Evidence for the Use of Exercise for Ulnar Neuropathy at the Elbow
There is 1 moderate-quality RCT incorporated into this analysis. There is 1 low-quality RCT in Appendix 2.(447) (Warwick 95)

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments

Svernlov 2009 RCT	4.5	N = 70 with mild to moderate cubital tunnel syndrome [Dellon grade; numbness and paraesthesias of ulnar forearm and hand, pain over ulnar nerve at elbow, tenderness and positive Tinel's over cubital tunnel (location unclear), and subjective intermittent weakness of hand intrinsic]. At least 3 months duration	Night splinting (pre-fabricated neoprene elbow brace, Rehband support 4823) vs. nerve gliding (6 positions, maintained for 30s, 3 reps, BID, gradually increased) (Byron 95) vs. control (education program as below). All received education on anatomy, probable mechanisms, avoidance of activities provoking symptoms; 6-month follow-up.	Canadian Occupational Performance Measures of performance (pre/6 months): splint (4.8±1.4/6.7±2.3) vs. nerve gliding (5.1±1.6/7.9±1.7) vs. information controls (4.4±1.3/6.5±1.8). Satisfaction scores also increased, but no differences between treatment groups.	"Patients with mild or moderate symptoms have a good prognosis if they are informed of the causes of the condition and how to avoid provocation."	NCS criteria not noted, and inching technique to localize to the cubital tunnel not stated. Duration of symptoms shorter in control (9.5 month) vs. splint (13.5 month) or nerve gliding (10.5 month), unclear if statistically significant but potential bias against splinting. Compliance unclear. Dropouts high especially in night splint group, yet no ITT analysis. Authors state most patients do not require NCS as 76% with typical symptoms were normal, 75% improved. Data suggest equal (in)efficacy; duration of symptoms at baseline concerning to have biased against night splint.

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

There is 1 low-quality RCT in Appendix 2.(461) (Hong 96)

Evidence for the Use of Nocturnal Elbow Splinting

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

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Svernlov 2009 RCT	4.5	N = 70 with mild to moderate cubital tunnel syndrome [Dellon grade; numbness and paraesthesias of ulnar forearm and hand, pain over ulnar nerve at elbow, tenderness and positive Tinel's over cubital tunnel (location unclear), and subjective intermittent weakness of hand intrinsic].	Night splinting (pre-fabricated neoprene elbow brace, Rehband support 4823) vs. nerve gliding (6 positions, maintained for 30s, 3 reps, BID, gradually increased) vs. control (education program as below). All received education on anatomy, probable mechanisms, and avoidance of activities provoking symptoms. 6-	Canadian Occupational Performance Measures of performance (pre/6mo): splint (4.8±1.4/6.7±2.3) vs. nerve gliding (5.1±1.6/7.9±1.7) vs. information controls (4.4±1.3/6.5±1.8). Satisfaction scores also increased, but no differences between treatment groups.	"Patients with mild or moderate symptoms have a good prognosis if they are informed of the causes of the condition and how to avoid provocation."	NCS criteria not noted; inching technique to localize to cubital tunnel not stated. Symptoms shorter in control (9.5 months) vs. splint (13.5 months) or nerve gliding (10.5 months), unclear if statistically significant but potential bias against splinting. Compliance unclear. Dropouts high especially in night splint group, yet no ITT analysis. Authors state most patients do not require NCS as 76% with typical symptoms were normal, 75% improved. Data suggest equal (in)efficacy, but

		At least 3 months duration.	months follow-up.			duration of symptoms at baseline concerning to have biased against night splint.

Evidence for the Use of Surgery for Ulnar Neuropathy

There are 5 moderate-quality RCTs incorporated into this analysis.

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Simple Decompression vs. Anterior Subcutaneous Transposition						
Bartels 2005 RCT	7.0	N = 152 with ulnar nerve palsy (sensory disturbance in digits 4-5 and ulnar hand, weak hand muscles with ulnar innervations, failure of conservative treatment, NCS confirmed. Duration at least 3 months	Simple decompression vs. anterior subcutaneous transposition. Encouraged immediate post-operative use; 1 year follow-up.	Completely free of signs/ symptoms SD vs. ATS 6 weeks after surgery: 12/75 (16.0%) vs. 17/77 (22.1%) (RR 0.7, 95% CI 0.4-1.4). At 1 year after surgery free of signs and symptoms SD 36/75 (48.0%) vs. ATS 46/77 (59.7%) (RR 0.8, 95% CI 0.6-1.1). Difference in outcome not statistically significant. Total complications in 7 simple decompression vs. 23 transposition, most sensibility loss around scar (14), (RR0.32, 95% CI 0.14-0.69) p <0.05 between groups.	"Although simple decompression and anterior subcutaneous transposition seemed to be equally effective methods of treatment, we favor simple decompression because of its surgical simplicity (less operative time and fewer complications)."	NCS criteria stated, although inching technique not apparently performed to localize lesion. Lack of independent investigator examination of most post-operatively (30 randomly selected examined by independent neurosurgeon). Data suggest no meaningful differences in outcome, but higher complication rate with transposition.
Nabhan 2005 RCT	4.5	N = 66 with ulnar nerve neuropathy (pain and progressive motor and sensory deficits, NCS confirmation, lack of response to conservative treatment)	Simple decompression (8cm incision) vs. anterior subcutaneous transposition (technique not referenced). 9-month follow-up.	Mean VAS scores comparing simple decompression vs. transposition (pre/ 3/ 9 months): 6/1/1 vs. 6/2/1 (NS). Ulnar intrinsic motor power decompression (4/5/5) vs. transposition (4/4/5) NS). No differences in sensory deficits. vs. 6/ 1 vs. 2/ 1 vs. 1. No differences were found in sensory deficits. Complications not reported.	"We recommend simple decompression of the nerve in cases without deformity of the elbow, as this is the less invasive operative procedure."	NCS performed, but inching technique to localize lesion to cubital tunnel not performed. Confounders addressed: Severity of ulnar nerve lesion comparable between groups; no significant differences between groups preoperatively for sensory deficits, degree of paresis, pain or nerve conduction velocity. Complications not reported. Data suggest outcomes comparable.
Simple Decompression vs. Anterior Submuscular Transposition						
Gervasio 2005 RCT	5.5	N = 70 with severe "cubital tunnel syndrome," Dellon's	Simple decompression (bupivacaine 0.5% local, 4cm proximal to 4cm	Bishop scoring system simple decompression 54.3% excellent, 25.7% good, 20% fair vs. transposition 51.43%	"No statistically significant difference was found between the two groups	Longer term follow-up. NCS criteria did not include inching technique to localize lesion to

		Grade 3 (includes persistent paresthesia, decreased vibration sense). NCS confirmed and criteria provided, but no inching technique to localize problem. Excluded subluxing ulnar nerves. Mean duration 25-27 months.	distal to epicondyle along length of ulnar nerve) vs. anterior deep submuscular transposition with z-lengthening (Learmonths' technique, general anesthesia). (Learmonth 42). Mean 47 months follow-up.	excellent, 31.43% good, 17.14% fair. No significant differences in outcomes. No differences in complications. Of those with no EMG/NCS sensory responses pre-operatively, 10/30 (33%) simple vs. 9/29 (31.0%) transposition had normal responses post-op (remainder had responses, though abnormal). For motor findings, 6/30 (20.0%) simple vs. 4/17 (23.5%) transposition had normalization (remainder regained some responses).	with regard to the clinical or the electrophysiological outcome. The surgical treatment gains in Group A and B were 80% and 82.86%, respectively (good to excellent results)."	cubital tunnel vs. condylar groove. Patient age, sex, affected side similar in both groups. In both groups, prevalence of left (non-dominant) side observed. Diabetes in 6 patients from Group A, 5 in Group B. Only other co-morbidity factor was use of amphiphilic cationic drugs in 2 patients from Group A, 1 in Group B. Data suggest no meaningful differences.
Biggs 2006 RCT	4.0	N = 44 with ulnar nerve entrapment at the elbow. NCS confirm-ed. Failed conservative treatment. Excluded subluxing ulnar nerves. Duration not stated.	Simple decompression (4cm proximal to 4cm distal to epicondyle incision, decompressed along length of nerve) vs. anterior submuscular transposition. (Kline 95) General anesthesia for all. Early mobilization; 1 year follow-up.	Simple decompression McGowan grades improved 13/23 (57%) vs. transposition 9/21 (45%), NS. LSUMC grading improved in 61% decompression vs. 67% transposition, NS. In moderate to high grade cases, 14/17 (82%) of decompression vs. 13/19 (68%) transposition improved.	"Idiopathic symptomatic ulnar nerve compression at the elbow is adequately treated by both neurolysis in situ and submuscular transposition. Submuscular transposition was associated with a higher incidence of complications. The authors therefore suggest the simpler procedure of neurolysis in situ as the treatment of choice. Submuscular transposition remains appropriate in certain circumstances."	NCS criteria not provided and unclear if pathology localized to cubital tunnel vs. condylar groove. Two groups not dissimilar, but trend towards lower grade lesions in simple decompression group (26% vs. 9.5%). No independent assessment of outcomes. More deep infections in transposition group (3 vs. 0); superficial infections in 19.0% transposition vs. 8.7% decompression. One dehiscence in transposition group. Data suggest trends of equivalent results, fewer complications with simple decompression.
Medial Epicondylectomy vs. Anterior Transposition						
Geutjens 1996 RCT	5.0	N = 43 with 47 ulnar neuropathy at elbow (clinical evidence of ulnar nerve lesion at elbow; slowed ulnar nerve conduction,	Medial epicondylectomy (King and Morgan 59) vs. anterior transposition (Adams 85). Mean 4.5 years follow-up.	No patients with spontaneous elbow pain post-operatively. Pain in hand ratings: 0±0 epicondylectomy vs. 0.45±0.82 transposition, p = 0.029. No differences in muscle atrophy or muscle power, or	"Our study showed better results after medial epicondylectomy; in particular patient satisfaction was higher than after ulnar nerve	Data not given on dropouts (n = 9) or at baseline for all. OA in 7, but no apparent cause in 36. Methods to blind assessor somewhat unclear. Data suggest medial

		no RA, no valgus deformity >5º compared with other elbow. Required persistent symptoms at least 3 months.		motor nerve conduction. Patient's opinion of cure was: epicondylectomy 12/25 (48%) vs. 6/22 (27.3%), p = 0.027. 92% of epicondylectomy patients would have procedure again vs. 68% transposition, p = 0.039.	transposition."	epicondylectomy superior to transposition.

Appendix Two: Low-quality Randomized Controlled Trials and Non-randomized Studies

The following low-quality randomized controlled studies (RCTs) and other non-randomized studies were reviewed by the Evidence-based Practice Elbow Panel to be all inclusive, but were not relied upon for purpose of developing this document's guidance on treatments because they were not of high quality due to one or more errors (e.g., lack of defined methodology, incomplete database searches, selective use of the studies and inadequate or incorrect interpretation of the studies' results, etc.), which may render the conclusions invalid. ACOEM's Methodology requires that only moderate- to high-quality literature be used in making recommendations.(540)

LATERAL EPICONDYLALGIA

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
			NSAIDs			
Stull 1986 RCT	2.0	N = 38 with "tennis elbow"	Diflunisal 1,000mg initially, followed by 500mg BID vs. 500mg of naproxen initially, followed by 250mg QID.	Overall pain relief, self reported favored diflunisal (100% good to excellent) vs naproxen (71% good to excellent), (p = 0.019). Self reported elbow limitations favored diflunisal, p = 0.039. No statistically significant differences between patients: 1) overall elbow condition; 2) overall rating of elbow pain; 3) elbow flexion; 4) elbow extension; 5) pronation; 6) supination; 7) pain reduction; 8) reduction in swelling; and 9) reduction in tenderness.	"[D]iflunisal and naproxen significantly reduce pain and inflammation associated with this condition. However, diflunisal provided more effective pain relief in the group studied. Prompt pain relief allows rapid progression to physical therapy and a return to normal activities. We also believe that diflunisal provides advantages of a longer-lasting effect and less frequent dosing, which may promote better patient compliance."	Open-label. Randomization unclear. Only baseline comparability of groups that is given relates to gender. Tables only have 16 or 17 in each group, as some participants apparently did not report. Most analyses were not statistically significant; however there were small numbers with multiple individuals refusing to answer questions, which may be sufficient to skew results. No placebo group.
Adelaar 1987 RCT	1.5	N = 18 with lateral, medial or "posterior" epi-condylitis	Diflunisal (initial dose of diflunisal 1000mg followed by diflunisal 500mg every 12 hours for a period of up to 15 days) vs. naproxen.	No statistically significant differences for any categories between study drugs or between pretest and post-test results at the fifth level single tail distribution. One patient receiving diflunisal developed transient nausea and stomach cramps though both study agents were generally well tolerated.	"Diflunisal and naproxen were generally effective in the treatment of mild to moderate pain associated with epicondylitis; there were no significant differences between the drugs."	Methods not well described. Open-label. Small study population. Short duration (15 days). No placebo group.

Toker 2008 RCT	1.5	N=21with lateral elbow pain with confirmed tennis elbow after physical examination.	Depomedrol 1mL plus prilocaine 1mL plus oral diclofenac plus topical etofenamate cream (n=11) vs. oral and topical anti-inflammatory treatment (n=10).	Anti-inflammatory group showed a significant improvement in pain scores from before and after treatment (p=0.026). The injection group showed a significant improvement as well (p=0.003).	"[S]ignificantly enhanced efficacy of the combination treatment used in this study might be limited to the short-term and that adverse effects of steroids on the tendons should be taken into consideration."	Sparse details. Unknown follow-up duration. No medication doses provided.
Topical NSAIDs and Other Agents						
Liow 2002 RCT	3.0	N=60 patients with Mason 1 and 2 radial head fractures	Immediate (24 hours after injury) exercise program to restore elbow movement (group A, n=30) vs. 5 day rest in broad arm sling before exercise program (group B, n=30). Follow ups at 1, 4 weeks, and 3 months.	VAS (mean±SD): week 1 (group A 5.9±2.0 vs. group B 7.6±1.9), p=0.002; week 4 and 12 (NS). ROM: extension deficit (NS); flexion week 1 (group A 112±14.9 vs. group B 98±14.2), p=0.0004; week 4 and 12 (NS); supination (NS); pronation (NS). Elbow strength and grip strength: extension (NS); flexion (NS); supination week 1 (58±2.9 vs. 47±2.2, p=0.0022), week 4 and 12 (NS); pronation (NS); grip strength (NS). Morrey Score: pain week 1 (10.3 vs. 6.3, p=0.009), week 4 and 12 (NS); ROM (NS); strength week 1 (16.1 vs. 14.7, p=0.035), week 4 and 12 (NS); function week 1 (8.2 vs. 5.4, p=0.012), week 4 and 12 (NS); total score week 1 (54.4 vs. 43.5, p=0.005), week 4 and 12 (NS).	"[T]his study has demonstrated the safety and early benefit of immediate active mobilization in Mason 1 and 2 radial head fractures. We have also shown that a delay of 5 days before mobilization was not detrimental and the final outcome of the two groups were similar."	Quasi-randomized by provider preference (next available fracture clinic). Data support early mobilization for minimally displaced fx.
Burton 1988 RCT	3.0	N = 33 with tennis elbow (pain, tenderness and at least 2 of pain with increased grip/twist/ lift, pain with resisted MF	All received manual therapy, 2 times a week for 1st week, then 1 times a week. Strap (Chen strap) all day vs. benzydamine topical cream 5 times a day vs. strap plus NSAID cream.		"The results do not show any therapeutic advantage from the use of these adjuncts, when assessed over three weeks, though the majority of patients in all groups were significantly improved."	Sparse details. Small sample sizes among 4 groups. No short or longer term followup. Likely underpowered for differences, especially in relatively acute population with better prognoses.

		extension, pain with pronation/ wrist flexion). Duration <3 months (mean 4.8 weeks).	No follow-up beyond 3 week trial.			
Kroll 1989 RCT	2.5	N = 173 acute musculo-skeletal disorders, mean 2-5 days (not well described proportions of: sprains and tendinitis of ankle sprain, AC joint sprain, supra-spinatus tendinitis, Achilles tendinitis, epicondy-litis)	Piroxicam 0.5% gel (3 cm of gel corresponding to 5 mg piroxicam) QID vs. diclofenac 1.16% (5 to 10 cm of gel corresponding to 20 to 40 mg diclofenac) QID for up to 14 days.	"Restriction of active movement" (baseline/2/4days): piroxicam (50.0±2.77/34.2±2.26/ 15.0±2.39) vs. diclofenac (50.9±2.92/37.8±2.63/ 9.8±1.81). Reductions in mean pain scores on joint movement, and tenderness also NS.	"The results of this study show that piroxicam 0.5% gel and diclofenac 1.16% gel are equally effective and well tolerated in the treatment of selected acute sprains and tendonitis."	Open label. Many disorders. Short term (therapy was begun within 3-5 days of injury and continued for up to 14 days). Study did not differentiate results by injury location (i.e., elbow, ankle, or shoulder), only by treatment (piroxicam vs. diclofenac) and injury type (sprains and tendinitis). Data suggest equal efficacy.
Tennis Elbow Straps, Bands, Supports, and Braces						
Luginbühl 2008 RCT	3.5	N = 36 enrolled, but 6 dropped out. 29 (30 elbows) with tennis elbow with no more than 3 injections in the prior 6 months.	All started with 2-3mL injection Triamcinolone/ Kenacort 40mg plus 1% Scandicain. Forearm support band vs. progressive isometric strengthening exercises vs combination.	Mean modified Nirschl Pettrone scores (pre/ last): Band (3.7±0.7/ 2.6±1.4) vs. exercise (3.4±0.7/1.7±1.3) vs. combination (3.1±0.7/ 1.8±1.4) NS. Subjective improvements of much better or better in 5/5 (50%) vs. 7/10 (70%) vs. 7/10 (70%). No differences in grip strength (p = 0.29).	"[W]e could not show any beneficial effect either for the forearm support band or for the strengthening exercises."	Trial consists of fairly resistant cases, thus generalizability of results may be similarly limited. High dropouts at year 1. Trend towards worse cases at baseline for band then exercise, may bias in favor of combination.
Holdsworth 1993 RCT	3.0	N = 36 with lateral epicondy-lits, duration 2 weeks to 18 months	Ultrasound (3MHz, 1.5W/ cm^2) with aqua-sonic 100 vs. phonophoresis (ultrasound with hydrocortisone 1% cream with dimethicone 330 2%) vs.	Mean subjective scores of pain at rest (pre/post): US 5.6/5.1 vs. Phono 14.3/12.2 vs. US plus clasp 5.6/7.8 vs. phono plus clasp 6.1/5.8. (Graph and data do not match. Graph suggests phono plus clasp far worse, but data suggest phono	"Our study has confirmed that ultrasound treatment does bring about a favourable response in the majority of patients. We found no suggestion that the application of a hydrocortisone coupling medium enhanced this	Small group sizes. Unclear if blinded ("independent") assessor. If so, study is moderate quality by score. Data suggest equivalency, but are likely underpowered for effects.

			ultrasound with clasp vs. phonophoresis with clasp. 12 treatments over maximum 6 weeks.	alone did worse).	favourable response."	
Burton 1988 RCT	3.0	N = 33 tennis elbow (pain, tendernes s; at least 2 of pain with increased grip/twist/ lift, pain with resisted MF extension, pain with pronation/ wrist flexion). Duration <3 months (mean 4.8 weeks).	All received manual therapy, 2 times a week for 1st week, then once a week. Strap (Chen strap) all day vs. Benzydamine topical cream 5 times a day vs. strap plus NSAID cream. No follow-up beyond 3 week trial.	Mean pain scores (pre/3 days/1 week/3 weeks): Strap plus NSAID (3.6/2.8/2.5/1.5) vs. NSAID cream (3.0/2.5/1.7/1.0) vs. Strap (3.2/2.8/2.5/1.6) vs. Manipulation only (3.2/2.8/2.5/1.5).	"The results do not show any therapeutic advantage from the use of these adjuncts, when assessed over three weeks, though the majority of patients in all groups were significantly improved."	Sparse details. Small sample sizes among 4 groups. No short or longer term followup. Likely underpowered for differences, especially in relatively acute population with better prognoses.
Altan 2008 Pseudo-randomized clinical trial	3.0	N = 50 (ages 34-60) with diagnosis of lateral epicondylit is (lateral elbow pain, tendernes s, pain with resisted wrist dorsi-flexion). Duration less than 12 weeks.	Lateral epicondyle bandage vs wrist splint (Rehband). To be worn "continuously"; 6 weeks follow-up.	Good responses at 2 and 6 weeks in 33.3% vs. 48% and at 6 weeks in 66.7% vs. 72% (NS). Lateral epicondyle bandage improved in all parameters (Pain at rest, pain with movement, sensitivity, algometer score, and hand grip strength) at 6 weeks. Wrist splint group also showed a significant improvement in all parameters by 6 weeks. No differences between groups other than at 2 weeks, where wrist splint favored.	"[E]picondyle bandage was not found to be superior to wrist splint in our study, we may suggest that it could be favored over splint since it is more practical and cosmetically acceptable."	Every other allocation. Mostly subacute patients (mean ~6 weeks). Data mostly suggest wrist splint and lateral epicondyle bandage equally efficacious.
Clements 1993 Pseudo-randomized clinical trial	2.5	N = 16 workers performing repetitive tasks with lateral epi-condylitis	Custom-made splint plus physiotherapy (US, ice stretch, strengthening) vs. physio-therapy alone. PT 3 times a week; 4 weeks follow-up.	Reported less pain, and grip-affected arm strength also better in splint plus PT group. (minimal data provided).	"[T]his custom-made splint is of value in facilitating the recovery from lateral epicondylitis."	Pseudorandomized (every other). States to be worn at night and daytime, but compliance numbers indicate worn less than 50% as directed. Sparse results. Small numbers of subjects.

Garg 2010 RCT	2.0	N = 70 lateral epi-condylitis, 42 (44 elbow) not lost to follow-up; acute patients (duration not described)	Velcro elbow strap vs. thumb spica wrist extension splint; 6 weeks follow-up.	American Shoulder and Elbow Society scores (pre/post): elbow strap (35.2±16.9/51.119.0) vs. wrist splint (40.7±25.2/54.3±16.6, p = 0.60).	"The wrist extension splint allows a greater degree of pain relief than does the forearm strap brace for patients with lateral epicondylitis."	Many details sparse. High dropouts. Baseline data sparse and suggest differences may be present. Most results suggest no difference between treatments.
Dwars 1990 RCT	1.5	N = 120 patients with tennis elbow	Elbow support (Epitrain) worn all day (n = 60) vs. physical therapy (friction massage plus stretching) (n = 60) for 6 weeks	No difference between groups for pain changes. Patients with elbow support more satisfied vs. physical therapy group.	"[T]he favorable results warrant the use of the elbow support for the treatment of tennis elbow."	Many details sparse. Results suggest support as effective as physical therapy.
Splints – Experimental Studies						
Jafarian 2009 Experimental, Randomized Crossover Study.	N/A	N=52 patients with lateral epicondylitis for at least 3 months.	All patients used a placebo, counterforce elbow strap, counterforce elbow sleeve, and a wrist splint in a randomized order.	Both elbow orthoses and wrist orthosis superior for pain-free grip strength vs. placebo ($p<0.02$).Values for pain-free grip were 135±77 (22-404) for placebo, 156±88 (20-466) for elbow strap, 156±91 (14-440) for elbow sleeve, and 129±74 (17-387) for wrist splint, $p \leq 0.003$. The values for the maximum grip were 161±95 (28-510) for placebo, 174±97 (22-567) for elbow strap, 175±95 (22-484) for elbow sleeve, and 142±73 (13-369) for wrist splint.	"The use of the 2 types of elbow orthoses (strap and sleeve) resulted in an immediate increase in pain-free grip strength."	No follow-up as experimental only. Data suggest elbow strap or sleeve may be superior to wrist splint or brace for pain free grip, however, without clinical follow-up, no firm conclusions for treatment possible.
Ng 2004 Experimental Study	N/A	N=15 patients with lateral humeral epicondylitis in their dominant arm.	Control vs. brace without tension vs. brace with 25 N of tension vs brace with 50 N of tension.	For within-subject effect of brace significant ($p=0.01$). Univariate tests revealed significant differences for wrist proprioception ($p=0.032$) and passive wrist extensors stretching pain threshold ($P=0.05$). Mean±SD joint position error comparing no brace vs. brace 0N vs. brace 25N vs. brace 50N: 0.5±4.6 vs. 0.3±5.0 vs. 2.4±4.9	"The counterforce forearm brace had no effect on isokinetic wrist extensor strength and stretch reflex latency of the extensor carpi ulnaris muscle in subjects with lateral humeral epicondylitis."	Experimental Study. No clinical follow-up. Data suggest counterforce brace increases pain threshold to passive stretch. Clinical relevance uncertain.

				(p<0.05) vs. 0.7±4.8; p<0.32.		
Exercise						
Luginbühl 2008 RCT	3.5	N = 36 enrolled (6 dropped out); 29 (30 elbows) with tennis elbow with no more than 3 injections in prior 6 months.	All 2-3mL injection triamcinolone/ Kenacort 40mg plus 1% Scandicain. Forearm support band vs. progressive isometric strengthening exercises vs. combination.	Mean modified Nirschl Pettrone scores (pre/ last): band (3.7±0.7/2.6 ±1.4) vs. exercise (3.4± 0.7/1.7±1.3) vs. combination (3.1±0.7/ 1.8±1.4), NS. Subjective improvements of much better or better in 5/5 (50%) vs. 7/10 (70%) vs. 7/10 (70%). No differences in grip strength (p = 0.29).	"[W]e could not show any beneficial effect either for the forearm support band or for the strengthening exercises."	Trial consists of fairly resistant cases, thus generalizability of results may be similarly limited. High dropouts at year 1. Trend towards worse cases at baseline for band then exercise, may bias in favor of combination.
Croisier 2007 Quasi Randomized	2.5	N=92 with unilateral chronic lateral epicondylar tendinopathy.	Passive standard rehabilitation program (control group) (n=46) vs. passive standard rehabilitation plus eccentric strength exercises (n=46).	By end of treatment, treatment group had a significantly lower VAS pain score compared to control (p<0.001). After treatment both groups improved in disability, but treatment group improved significantly compared to control (p<0.001).	"[A] patient with chronic lateral epicondylar tendinopathy has more than two times a greater chance of obtaining relief with eccentric intervention."	Quasi randomized with matching on age, gender and activity level. Timing appears variable. Many details sparse.
Tyler 2010 RCT	2.5	N=21 with chronic lateral epicondylitis for 6 weeks or longer.	Eccentric training (n=11) vs. standard treatment (n=10).	The eccentric group improved significantly in DASH (p=0.01), VAS pain (p=0.002), combined strength (p=0.011), and tenderness deficit (p=0.003) compared to the standard group.	"All outcome measures for chronic lateral epicondylitis were markedly improved with the addition of an eccentric wrist extensor exercise to standard physical therapy, compared with physical therapy without the isolated eccentric exercise."	Small groups. Many details sparse. Data suggest eccentric group modestly superior.
Clements 1993 Pseudo-randomized clinical	2.5	N = 16 workers performing repetitive tasks with lateral epi-condylitis.	Custom-made splint plus physiotherapy (US, ice stretch, strengthening) vs. physio-therapy alone. PT 3 times a week; 4 weeks follow-up.	Reported less pain, and grip-affected arm strength also better in splint plus PT group. (minimal data provided).	"[T]his custom-made splint is of value in facilitating the recovery from lateral epicondylitis."	Pseudorandomized (every other). States to be worn at night and daytime, but compliance numbers indicate worn less than 50% as directed. Sparse results. Small number of subjects.

Svernlöv 2001 RCT	2.0	N = 38 with lateral epicondy-lalgia. All lateral elbow pain, tender to palpation, pain with resisted wrist extension, positive middle finger test. Mean durations 8.4 to 10.7 months.	Group S (stretching, contract-relax-stretching program) vs. Group E (eccentric, eccentric exercises). Daily HEP exercises for 12 weeks. Forearm bands with activity and wrist support nightly in both groups. 12months follow-up.	Mean VAS scores before training vs. after 3 months: At rest: 0.9 vs. 0.1; p <0.0001. At palpation: 5.0 vs. 2.3; p <0.0001. Pain on isometric testing: 5.3 vs. 1.3; p = 0.0002. Pain during middle finger test: 5.5 vs. 2.4; p <0.0001. Pain during grip strength testing: 2.9 vs. 0.6; p <0.0001. Complete recovery in 12/17 (71%) of eccentric exercise vs. 7/18 (39%) stretching, p = 0.09.	"The eccentric training regime can considerably reduce symptoms in a majority of patients with lateral humeral epicondylalgia, regardless of duration, and is possibly superior to conventional stretching."	Pilot study. Some baseline differences, including steroid injections (4/15 vs. 9/15). Baseline table is of completions. Data suggest eccentric exercises superior to stretching.
Dwars 1990 RCT	1.5	N = 120 patients with tennis elbow	Elbow support (Epitrain) worn all day (n = 60) vs. physical therapy (friction massage plus stretching) (n = 60) for 6 weeks.	No difference between groups for pain changes. Patients with elbow support more satisfied vs. physical therapy group.	"[T]he favorable results warrant the use of the elbow support for the treatment of tennis elbow."	Many details sparse. Results suggest support as effective as physical therapy.
Ultrasound						
Holdsworth 1993 RCT	3.0	N = 36 with lateral epi-condylitis. Duration 2 weeks-18 months.	Ultrasound (3MHz, 1.5W/cm^2) with aquasonic 100 vs. phonophoresis (ultrasound with hydrocortisone 1% cream with dimethicone 330 2%) vs. ultrasound with clasp vs. phonophoresis with clasp; 12 treatments over maximum 6 weeks.	Mean subjective scores of pain at rest (pre/post): US 5.6/5.1 vs. Phono 14.3/12.2 vs. US plus clasp 5.6/7.8 vs. phono plus clasp 6.1/5.8. (Graph and data do not match. Graph suggests phono plus clasp far worse, but data suggest phono alone did worse).	"Our study has confirmed that ultrasound treatment does bring about a favourable response in the majority of patients. We found no suggestion that the application of a hydrocortisone coupling medium enhanced this favourable response."	Small group sizes. Unclear if blinded ("independent") assessor. If so, study is moderate quality by score. Data suggest equivalency, but are likely underpowered for effects.
Halle 1986 RCT	2.0	N = 48 with lateral epi-condylitis (pain over common extensor origin with resisted wrist extension and point tenderness over epicondyle)	Ultrasound with coupling agent vs. ultrasound with 10% hydrocortisone coupling agent vs. transcutaneou s electrical nerve stimulation vs. hydrocortisone and lidocaine	Pain Intensity Index: US 16.5 vs. US with hydrocortisone 13.5 vs. TENS 1.5 vs. Injection 2.5 (latter 3 p<0.05). Pain rating index total: US 7.5 vs. US with hydrocortisone 16.0 vs. TENS 7.0 vs. Injection 3.0 (all but US with hydrocortisone p<0.05). Comparing	"While no difference was demonstrated to exist between the four treatment protocols, it was shown that improvement, as measured by the pain indexes, did occur over all four treatment groups when the pre-treatment and post-treatment values were compared."	Much of study not well described. No placebo. Short follow up (5 days). Poor blinding, though ultrasound attempted blinding. No description of randomization/ confounders – no discussion of individual group demographics. One-tailed t-tests.

			injection. Treatment details not provided. Treatments QD for 5 days except injection. All treated with elbow cuff, avoiding strenuous activity, ice massage BID; 5 days treatment.	pre/post tests: US 69% of variables improved, 12% same, and 19% worse. US with hydrocortisone 65% improved, 12 % same, 23% worse. TENS 56% improved, 23% same, 21% worse. Injections 63% improved, 25% same, 12% worse.		Conclusions of lack of differences between groups appear likely underpowered and incorrect.
Manipulation and Mobilization						
Fernández-Carnero 2008 RCT	3.5	N = 10 with lateral epi-condylitis ages 30 to 49 years who responded to a local advertisement; duration unclear.	Cervical spine manipulation (high velocity, low amplitude thrust manipulation directed at C5-6) vs. manual contact (simulated, but no thrust). No follow-up beyond 2 treatments (about 48 hours).	Both groups similar pain threshold values for dominant (p = 0.2)/nondominant (p = 0.3). Hot pain thresholds not different for dominant (p = 0.8)/ nondominant (p = 0.4). Cold pain thresholds similar, dominant (p = 0.8) and nondominant (p = 0.7). Pain free grip not different between groups (p = 0.3).	"No significant changes for HPT and CPT were found. Finally, cervical manipulation increased PFG on the affected side, but not the MGF on the unaffected arm."	Inadequate sample size. Study design somewhat unclear as possible crossover trial. No short or intermediate term results. Results suggest no differences, but likely underpowered if there is an effect.
Radpasand 2009 RCT	3.5	N= 6 with chronic lateral epicondylitis for at least 6 months and diagnosed by at least 2 of the following tests: palpation, resisted wrist extension, resisted finger extension, and resisted extension of the middle finger. 12 week study with 4 follow-ups.	Group A (n=4): high-velocity low-amplitude manipulation (delivered as a HVLA thrust), high-voltage pulse galvanic stimulation, counterforce bracing (used hard pad's knob exactly located on top of most painful area), ice (applied ice for 10 minutes and removed for 15 minutes. Repeated twice 3 times per day), and exercises (forearm supinator and pronator muscles; forearm extensor and flexor muscle exercise,	Group A vs. Group B: 59% vs. 9.5% change for PRTEE (Patient-Rated Tennis Elbow Evaluation) total, 3.2 % vs. 169.0% change for PFGS (Pain-Free Grip Strength), and 51.4% vs. 65.1% VAS_24hs.	"The pilot study demonstrated that the study design is feasible and that patients could be recruited for a 12-week trial of multimodal treatment. A large trial is warranted in a multicenter setting to detect difference in the effects of these treatment strategies."	The direct aim of this study is not about the effectiveness of the treatments. Small sample size with uneven numbers in the groups. Pilot study.

			forearm supinator and pronator muscle exercise, and putty therapeutic exercise. Contractions performed for 10 seconds with 10 repetitions twice a day) vs. Group B (n=2) with ultrasound (3 MHz, 1.5 W/cm2, and pulsed mode of 1 millisecond on and 5 milliseconds off for 8 minutes), counterforce bracing, and exercise.			
Drechsler 1997 RCT	3.0	N = 18 with lateral epi-condylitis (criteria unclear). Duration unclear.	Neural tension group (mobilize radial head with wrist flexion/ shoulder abduction; anterior-posterior mobilizations) plus HEP vs. standard treatment (US 1.0-1.5W/cm^2, 3MHz, 5 minutes; transverse friction massage, stretching, strengthening, HEP). Average 2 times a week 6 weeks; 3 months follow-up.	Occupational status (pre/post/3 month): NT (2.0/1.5/1.23) vs. standard (1.5/1.6/1.5). Grip strengths NT (73.25/85.12/87.12) vs. standard (92.6/97.7/92.5).	"Results of the NTG (neural tension group) treatment were linked to the radial head treatment, and isolated effects of the NTG treatment could not be determined. There were no long-term positive results in the (standard treatment group)."	Small sample sizes that preclude quality assessments. Baseline differences (e.g., mean grips 73 vs. 92 pounds). Multiple co-interventions. All received HEP. No placebo/sham control.
Burton 1988 RCT	3.0	N = 33 with tennis elbow (pain, tenderness, at least 2 of pain with increased grip/twist/ lift, pain with resisted MF	All received manual therapy, 2 times a week for first week, then once a week. Strap (Chen strap) all day vs. Benzydamine topical cream 5 times a day vs.	Mean pain scores (pre/3 days/1 week/3 weeks): Strap plus NSAID (3.6/2.8/2.5/1.5) vs. NSAID cream (3.0/2.5/1.7/1.0) vs. Strap (3.2/2.8/2.5/1.6) vs. Manipulation only (3.2/2.8/2.5/1.5).	"The results do not show any therapeutic advantage from the use of these adjuncts, when assessed over three weeks, though the majority of patients in all groups were significantly improved."	Sparse details. Small sample sizes among 4 groups. No short or longer term follow-up. Likely underpowered for differences, especially in relatively acute population with better prognoses.

		extension, pain with pronation/ wrist flexion). Duration less than 3 months (mean 4.8 weeks).	strap plus NSAID cream. No follow-up beyond 3 week trial.			
Nourbakhsh 2008 RCT	2.5	N = 23 (age 24-72) with lateral epi-condylitis; duration at least 3 months (means 17 and 20 months).	Oscillating-energy manual therapy (OMET) vs placebo (sham). 6 treatments over 2 to 3 weeks. No subsequent follow-up in both groups.	Grip strengths (pre/post: OMET (61.3/73.6) vs. sham (81.1/79.2). OMET with improved pain intensity (p = 0.000), functional level (p = 0.000), and pain limited activity (p = 0.004). Placebo group did not improve.	"[O]MET could significantly improve the symptoms of chronic LE in a relatively short period of time."	Unclear how 2 RCTs run simultaneously. Trial claims double blinding, but patient blinding not plausible when manual therapy differed. Blinding/sham adequacy not assessed; small sample, unclear how many drops. Major baseline difference in grip strength suggests randomization failure. Reductions in grip strength post-treatment unexplained.
Massage, Including Friction Massage						
Dwars 1990 RCT	1.5	N = 120 patients with tennis elbow	Elbow support (Epitrain) worn all day (n = 60) vs. physical therapy (friction massage plus stretching) (n = 60) for 6 weeks	No difference between groups for pain changes. Patients with elbow support more satisfied vs. physical therapy group.	"[T]he favorable results warrant the use of the elbow support for the treatment of tennis elbow."	Many details sparse. Results suggest support as effective as physical therapy.
Extracorporeal Shockwave Therapy						
Melegati 2004 RCT	3.5	N = 41 with lateral epi-condylitis	Extracorporeal shockwave therapy with lateral tangential focusing vs. back tangential focusing.	No statistically significant difference between groups in initial TESS and VAS (p >0.05), but both groups did make a significant increase in TESS follow up scores (p <0.05) and significant decrease in VAS (p <0.05).	"According to TESS and VAS scores both localization techniques gave a decrease of symptoms but did not eliminate the pain." "There was no difference between the two techniques of using ESWT."	Confounders addressed age, gender, duration of symptoms. No placebo group. Evaluations compiled by same physician who performed ESWT. No drop outs. Did not state intent-to-treat analysis. No difference between techniques.
Rompe 2001 Prospective RCT/ Matched Prospective Trial	3.5	N = 60 diagnosed with lateral epicondylitis who did not respond to conservativ	30 patients received 1000 impulses of shock waves once a week for 3 weeks and also received	At 3 months, 12 patients in group 1 and 15 patients in group 2 had an excellent or good condition. At 12 months, 15 patients in group 1 and 15	The authors concluded "ESWT may be an effective conservative treatment for unilateral chronic tennis elbow. The efficacy of additional	Many details sparse. Data suggest cervical manipulation of no additive benefit to ESWT.

		e treatment for 6 months or longer.	manual therapy to the cervical spine (group 1) vs. 30 patients received 1000 impulses of shock waves once a week for 3 weeks (group 2) with follow-ups at 3 months and 12 months.	patients in group 2 had a good or excellent condition. No significant differences found between two groups. Within the 2 groups, significant difference in the improvement on the VAS and on Roles and Maudsley outcome scores at both follow-ups ($p<0.001$)	cervical manual therapy for lateral epicondylitis remains questionable."	
Melikyan 2003 RCT	2.5	N = 74 with chronic lateral epi-condylitis awaiting surgery	Extracorporeal shockwave therapy vs. sham. 12 months follow-up.	No difference between groups at any point or in rate of improvement of score ($p = 0.87$). Mean pain on lifting 5kg dumbbell decreased significantly over time in both groups ($p <0.001$), NS between groups. Grip strength with elbow flexed 90° and arm adducted (M1) not improved in either group (baseline, 29.5kg; 12 months, 34.2kg, $p = 0.22$). Mean grip strength (M2) improved (baseline, 21.2kg; 12 months, 32.4kg; $p <0.001$). No difference between groups before treatment ($p = 0.77$ and $p = 0.93$, for M1/ M2) or follow-up ($p = 0.38$ and $p = 0.65$).	"We have not been able to show a significant difference between the treatment and the control groups in respect of any of the measured parameters at this dosage." "Study showed no evidence that extracorporeal shock-wave therapy for tennis elbow is better than placebo."	Confounders addressed age, gender, and use of analgesics. Both treatment and placebo trended towards improvement. There was no difference in the proportion of patients using analgesics at any stage.
Crowther 2002 RCT	2.0	N = 93 with tennis elbow	Steroid injection (triamcinolone 20mg plus lignocaine) vs. extracorporeal shockwave therapy; 3 months follow-up.	Group 1 (steroid injection); 6 weeks after injection, mean VAS fell from pre-treatment level of 67 to 21, and at 3 months 12. Group 2 (ESWT) VAS score fell from 61 before treatment to 35 at 6 weeks after end of treatment (tailed t-test, $p = 0.052$) and to 31 at 3 months. Using a reduction of pain of 50% as a criterion of success at 3 months after treatment end, 21 (84%) of Group 1 had pain reduction ≥50% vs. 29 (60%) of Group 2 (chi-squared test, $p <0.05$).	"Our results have shown that injection of steroid and local anaesthetic was more effective than ESWT in the treatment of lateral epicondylitis, although both treatments relieve symptoms."	Confounders addressed: age and gender. Data suggest steroid injection superior to ESWT.

Phonophoresis						
Holdsworth 1993 RCT	3.0	N = 36 with lateral epi-condylitis. Duration 2 weeks to 18 months.	Ultrasound (3MHz, 1.5W/cm^2) with aquasonic 100 v. phonophoresis (ultrasound with hydrocortisone 1% cream with dimethicone) vs. ultrasound with clasp (Thämert) v. phonophoresis with clasp; 12 treatments maximum 6 weeks.	Mean subjective scores of pain at rest (pre/post): US 5.6/5.1 vs. Phono 14.3/12.2 vs. US plus clasp 5.6/7.8 vs. phono plus clasp 6.1/5.8. (Graph and data do not match. Graph suggests phono plus clasp far worse, but data suggest phono alone did worse).	"Our study has confirmed that ultrasound treatment does bring about a favourable response in the majority of patients. We found no suggestion that the application of a hydrocortisone coupling medium enhanced this favourable response."	Small group sizes. Unclear if blinded ("independent") assessor. If so, study is moderate quality by score. Data suggest equivalency, but are likely underpowered for effects.
Low-level Laser Therapy						
Emanet 2010 RCT	3.5	N= 49 having symptoms of lateral epicondylit is less than 3 months duration	Patients received 15 sessions of laser (Endolaser 422-230 VAC, laser probe one diode laser, LP 100) to most sensitive points around lateral epicondyle with dose of 1 J/cm² for 2 minutes (5d per week for 3 weeks) (n=25) vs. placebo group which received same protocol by same physiotherapist : without device being turn. Follow-up at 0/3/12 weeks.	No significant differences were found between groups though at 12 weeks both group had significant improvement.	"Although low energy laser therapy had no advantage compared to placebo in patients with LE for the short term, a significant improvement, particularly in functional parameters, was achieved in the long term. Laser, which has relatively no side effects, might be included among long-term treatment options for LE."	Some data suggest place group worse at baseline. Sequential allocations. Less than 3 month duration. Quasi randomized trial with 12 weeks follow-up.
Simunovic 1998 RCT	2.5	N = 324 with medial or lateral epicon-dylitis (case definitions not provided) durations unclear	Patients with bilateral symptoms all underwent trigger point technique (tender point). Patients with unilateral symptoms randomly allocated to 1	No significant differences between 2 groups when both centers combined. Statistically significant difference was found between the groups with the scanner technique ($p < 0.05$). In acute cases, scanner technique was favored over TPs ($p > 0.001$).	"The current clinical study provides further evidence of the efficacy of LLLT in the management of lateral and medial epicondylitis."	Stated technician was blinded but unclear how that could have been. Not stratified, analyses use both lateral and medial epicondylitis combined. Lack of analyses and smaller numbers of medial epicondylitis suggests non-significant results.

		though at minimum include subacute and chronic	of 3 treatment groups: trigger points, scanner, and combination therapy.	For acute and chronic a significant difference was found favoring scanner technique over combination technique (p < 0.001).		Strong potential for bias (as seen in combination vs. each location analyses). Many details sparse, including unclear methodology, selection, case definition, and administration of treatments.
Acupuncture						
Tsui 2002 RCT	1.5	N = 20 with pain over lateral epicondyle	Manual acupuncture (MA) (n=10) vs. electro-acupuncture (EA) (n = 10) 3 times a week for 2 weeks. Study duration unclear, possibly no follow-up beyond 2 weeks (not stated).	Pain VAS scores favored EA vs. MA (p<0.001) and EA. Pain free grip better in both groups vs. baseline control (p<0.05).	"[B]oth MA and EA group have significant differences in pain relief compare with control group….There were significant pain reduction and greater improvement in handgrip strength in the EA group than the MA group."	Small sample size. Some text no understandable. Patients not described. Many details sparse. Time and outcomes unclear.
Electrical Stimulation						
Reza Nourbakhsh 2008 RCT	3.5	N = 18 (ages 24 to 72) with lateral epi-condylitis (apparently required all of tenderness, Cozen's Mill's middle finger extension tests) Duration at least 3 months (means 14 and 23 months).	Noxious level electrical stimulation (4Hz, DC for 30s to the most tender point, "adjusted to the subject's pain tolerance level") vs placebo stimulation (sham). 6 treatments over 2-3 weeks. No subsequent follow-up in both groups as sham received active treatment after trial.	Grip strengths (pre/post): E-stim (70.4/90.2) vs. sham (91.5/89.2), p = 0.04. Pain intensity: E-stim (4.2/1.1) vs. sham (3.85/4.0), p = 0.01. Noxious level e-stim superior for functional level (p = 0.013), and pain-limited activity (p = 0.003).	"[T]reating tender points over the lateral epicondyle with low-frequency hyperstimulation could clinically improve pain, grip strength, limited activity due to pain and functional activities in subjects with chronic lateral epicondylitis."	Unclear how 2 RCTs run simultaneously and whether double enrolled. Trial claims double blinding, but patient blinding not plausible when "noxious" level stimulation used and adjusted to patient tolerance level. Adequacy of sham/ blinding not measured. Sham/placebo likely more equivalent to no treatment. Small sample; baseline grip strengths different between groups, apparent randomization failure may invalidate results. Methodological issues result in a low quality trial.
TENS						
Weng 2005 Randomized Crossover Trial	2.0	N=20 patients between the ages of 20-30 with tennis elbow pain for at least	5 KHz modulated by 2 Hz frequency mode TENS on acupuncture points LI10 and LI11 (LF	VAS (before/after): control (4.80±1.93/4.95±2.01) vs. LF (4.40±2.16/3.70±2.00, p<0.05) vs. HF (4.16±2.37/3.42±2.01, p<0.05). Percentage	"[A]cupuncture-like TENS with modulated frequency may be a good treatment choice for patients with tennis elbow pain."	Patients not described. Many details sparse.

		3 months	group) vs. 5 KHz modulated by 100 Hz frequency mode of TENS on acupuncture points LI10 and LI11 (HF group) vs. sham TENS (control group) 15 minutes per visit, 3 times a week for 2 weeks.	change in VAS: control (4.16±25.0, p<0.05) vs. LF (-18.51±18.1, p<0.05) vs. HF (-16.32±16.56, p<0.05).		
Glucocorticoid Steroid Injections						
Saartok 1986 RCT	3.0	N = 21with lateral epi-condylitis	Naproxen 250mg BID for 2 weeks (initial 500mg dose) vs. betamethasone 6mg plus prilocaine injection (long acting form given as injection). Follow-up unclear, but possibly 2 weeks.	Grip strength improved 9% in naproxen vs. 2% betamethasone (NS). Doctor's evaluations were50% improved on naproxen vs. 40% with injection at 2 weeks (NS).	"The results of this pilot study indicate that oral naproxen (250 mg twice daily for two weeks) is as effective as a single injection of a corticosteroid into the site of tenderness in the treatment of epicondylitis."	Small sample. Groups well matched for variables: age, sex, duration of present condition, chronicity and probable causative factor. Previous history of other disorders of locomotor system more common in naproxen group (8 vs. 3). Data suggest no differences over short duration, likely underpowered.
Halle 1986 RCT	2.0	N = 48 with lateral epi-condylitis (pain over common extensor origin with resisted wrist extension and point tendernes s over epicondyle)	Ultrasound with coupling agent vs. ultrasound with 10% hydrocortisone coupling agent vs. transcutaneous electrical nerve stimulation vs. hydrocortisone and lidocaine injection. Details of treatment not provided. Treatments QD for 5 days except injection. All treated with elbow cuff, avoiding strenuous activity, ice massage BID. Five days treatment.	Pain Intensity Index: US 16.5 vs. US with hydrocortisone 13.5 vs. TENS 1.5 vs. Injection 2.5 (latter 3 p <0.05). Pain rating index total: US 7.5 vs. US with hydrocortisone 16.0 vs. TENS 7.0 vs. Injection 3.0 (all but US with hydrocortisone p <0.05). Comparing pre/post tests: US 69% of variables improved, 12% same, and 19% worse. US with hydrocortisone 65% improved, 12 % same, 23% worse. TENS 56% improved, 23% same, 21% worse. Injections 63% improved, 25% same, 12% worse.	"While no difference was demonstrated to exist between the four treatment protocols, it was shown that improvement, as measured by the pain indexes, did occur over all four treatment groups when the pre-treatment and post-treatment values were compared."	Much of study not well described. No Placebo. Short follow up (5 days). Poor blinding, though ultrasound attempted blinding. No description of randomization/confou nders – no discussion of individual group demographics. One-tailed t-tests. Conclusions of lack of differences between groups appear likely underpowered and incorrect.
Toker	1.5	N = 21	Depomedrol	Anti-inflammatory	"[S]ignificantly	Sparse details.

2008 RCT		with lateral elbow pain with confirmed tennis elbow after physical exam.	1mL plus prilocaine 1mL plus oral diclofenac plus topical etofenamate cream (n=11) v. oral and topical anti-inflammatory treatment (n=10).	group showed a significant improvement in pain scores from before and after treatment (p=0.026). The injection group showed a significant improvement as well (p=0.003).	enhanced efficacy of the combination treatment used in this study might be limited to the short-term and that adverse effects of steroids on the tendons should be taken into consideration."	Unknown follow-up duration. No medication doses provided.

MEDIAL EPICONDYLALGIA

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Simunovic 1998 RCT	2.5	N = 324 with medial or lateral epicondy-litis (case definitions not provided) durations unclear though at minimum include subacute and chronic	Patients with bilateral symptoms all underwent trigger point technique (tender point). Patients with unilateral symptoms randomly allocated to one of 3 treatment groups: trigger points, scanner, and combination therapy.	No significant differences between groups when both centers combined. Statistically significant difference between groups with scanner technique (p <0.05). In acute cases, scanner technique favored over TPs (p >0.001). For acute and chronic a significant difference favored scanner over combination technique (p < 0.001).	"The current clinical study provides further evidence of the efficacy of LLLT in the management of lateral and medial epicondylitis."	Stated technician blinded, but unclear how possible. Not stratified, analyses use both lateral and medial epicondylitis combined. Lack of analyses and smaller numbers of medial epicondylitis suggests non-significant results. Strong potential for bias (as seen in combination vs. each location analyses). Details sparse, unclear methodology, selection, case definition, treatment administration.
Adelaar 1987 RCT	1.5	N = 18 with lateral, medial or "posterior" epi-condylitis	Diflunisal (initial dose of diflunisal 1000mg followed by diflunisal 500mg every 12 hours for a period of up to 15 days) vs. Naproxen.	No statistically significant differences any categories between study drugs or pre- and post-test results at 5th level single tail distribution. One patient receiving diflunisal developed transient nausea and stomach cramps though both study agents generally well tolerated.	"Diflunisal and naproxen were generally effective in the treatment of mild to moderate pain associated with epicondylitis; there were no significant differences between the drugs."	Methods not well described. Open-label. Small study population. Short duration (15 days). No placebo group.

OLECRANON BURSITIS

Author/Year Study Type	Score (0-11)	Sample Size	Comparison Group	Results	Conclusion	Comments
Aspiration						

Weinstein 1984 Controlled clinical trial	3.5	N=60 males with traumatic olecranon bursitis followed 31 months (range 6-62).	Bursal aspiration vs. aspiration plus corticosteroid injection. Techniques and doses may have varied.	Final data obtained from 49 (82%). Faster resolution with steroid injection (graphic interpretation: effusions in 4% vs. 28% at 4wks).	"[L]ocal corticosteroid is an effective treatment for traumatic olecranon bursitis, the high incidence of side effects and self-limiting nature of the condition indicate conservative therapy for most patients."	Not randomized. Clinical trial. Many details sparse. Data suggest complications occurred in those treated with corticosteroid injection.

ELBOW FRACTURES

Author/Year Study Type	Score (0-11)	Sample Size	Comparison Group	Results	Conclusion	Comments
Immobilization						
Van Leemput 2007 Pseudo-randomized clinical trial	3.0	N = 102 allocated by date of hospital; excluded open fractures, <18 years, obvious signs of infection in fracture, and multiple traumas.	Immobilization in below-elbow for 3 weeks vs. above-elbow for 3 weeks vs. below-elbow for 6 weeks vs compression bandage and immediate mobilization for 6 weeks; 12 weeks follow-up.	Bony healing times above/below 3 weeks 10.7 weeks (12.5% delayed union) vs. 6 weeks 10.5 weeks (13.9% delayed union) vs. no plaster cast 10.4 weeks (11.8% delayed union), NS. No differences in VAS scores, loss of rotation arc, loss of flexion/extension arc, or bony healing time.	"[A]ll three different conservative treatment strategies were compared and showed good comparable results in terms of healing, healing time, pain and function."	Randomization by date of presentation. Data suggest equal efficacy.

ULNAR NEUROPATHIES – CUBITAL TUNNEL

Author/Year Study Type	Score (0-11)	Population	Comparison Group	Results	Conclusion	Comments
Range of Motion Exercises						
Warwick 1995 RCT	2.5	N = 57 after cubital tunnel release surgery with medial epicondylectomy.	Physical therapy group with active and passive range of motion (ROM) exercises started 14 days postoperatively (n=29) vs. same treatment regiment started 3 days postoperatively.	Final elbow ROM for extension for those not achieving full active extension comparing group 1 vs. group 2: 51% vs. 4%; p<0.001.	"[B]etter results can be obtained by starting rehabilitation immediately following cubital tunnel surgery with medial epicondylectomy."	Data suggest early mobilization superior for ROM and RTW (2.2 vs. 4 months)
Glucocorticoid Steroid Injections						
Hong 1996 RCT	3.5	N = 10 men with 12 ulnar nerve lesions at the elbow. All showed signs and	Nocturnal splint therapy only (n=5 nerves) vs. splint plus triamcinolone 40mg plus lidocaine 1%	Severity of symptoms (pre/1mo/6mo): splint (3.4±0.8/1.6±1.2/1.8±1.1) vs. combined	"[S]plinting alone seems to be adequate for treatment of ulnar neuropathy at the elbow, since local steroid injection did	Small sample sizes. No mention of definition of ulnar neuropathy, especially condylar groove vs. cubital tunnel with NCS, which may be

		symptoms of ulnar neuropathy. Nerve conduction tests used, but not well described.	2mL into the cubital tunnel and around ulnar nerve (n= 7 nerves). Follow-up at 1 and 6 months.	(3.3±0.9/1.7±0.8/1.1±0.8), NS between treatments. Both groups also improved with signs, but NS. No change in sensory conduction was in either group at 1 or 6 months ($p>0.05$). Both groups did not differ.	not offer any additional benefit."	critical.

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