

CHAPTER 10

ELBOW DISORDERS (REVISED)

IMPACT

Upper-extremity musculoskeletal disorders continue to account for a significant number of work-related illnesses and disabilities in the United States (US). According to the US Bureau of Labor Statistics, non-traumatic musculoskeletal account for 65% of all occupational illnesses in the US.¹ Work-related elbow disorders are among the most common causes of reported occupational injuries and workers' compensation claims. These disorders are broadly and most accurately classified as musculoskeletal disorders.² In 2005 alone, musculoskeletal disorders accounted for 30% of the injuries and illnesses with days away from work.³ Specifically, in 2005, 31.5% of elbow injuries resulted in 31 days or more away from work (with a median of 14 days).⁴

Upper extremity musculoskeletal disorders, which include the elbow, now account for at least 4% of all state workers' compensation claims, a dramatic increase from the 1% seen a decade ago.^{5,6,7} The State of Washington, for example, in reviewing its workers' compensation claims from 1987 to 1995, found that elbow disorders accounted for the third highest incidence rate with 29.7 injuries per 10,000 full-time employees.⁸

GENERAL SUMMARY OF RECOMMENDATIONS

Recommendations for assessing and treating patients with elbow disorders:

- The initial assessment of patients with acute and subacute elbow problems should focus on detecting clinical indications of potentially serious disease, termed red flags, and determining an accurate diagnosis.
- In the absence of red flags, health care providers can safely and effectively manage work-related elbow disorders. Management should focus on monitoring patients for complications, facilitating the healing process, and returning the individual to modified, alternative, or full-duty work.
- One role of the physician or other health care provider (e.g., physical therapist, occupational therapist, nurse, etc.) is to identify and correct or modify the offending or aggravating activity. Consultation with a qualified professional trained in ergonomic analysis can be helpful. Equipment may need to be serviced or adjusted to reduce the force required to accomplish a job task or to reduce vibration. Posture and work technique may need to be changed to address, for example, excessive grip force, contact pressure, or sustained wrist extension. Ergonomic biomechanical advice on the efficient use of the elbow is helpful. For example, with lateral epicondylalgia/epicondylitis/tendinosis, it is generally correct to lift with palm up and not palm down to reduce stress on the lateral elbow (caused by resisted wrist extension). For medial epicondylalgia/epicondylitis/tendinosis, it is generally correct to lift palm down to avoid stress on the medial elbow (caused by resisted wrist flexion).
- Relieving discomfort can be accomplished most safely by temporarily decreasing or modifying the offending activities and by prescribing systemic or topical non-prescription analgesics along with an adjustable, properly fitted elbow support. Patients recovering from acute and subacute elbow problems should be encouraged to continue working. Modified duty may be recommended if appropriate.
- In general, immobilization should be avoided. An exception is immediately after surgery where brief immobilization may be required. Wrist splinting is sometimes utilized. However, some experts believe splinting potentially contributes to elbow pain. When immobilization is utilized, range-of-motion exercises should involve the elbow, wrist, as well as the shoulder, to avoid frozen shoulder ("adhesive capsulitis").

- If significant symptoms causing self-limitations or restrictions persist beyond 4–6 weeks, referral for specialty evaluation (e.g., occupational medicine, physical medicine and rehabilitation, or orthopaedic surgery) may be indicated to assist in the confirmation of the provisional diagnosis and in the determination of further management.
- A careful search for regional or systemic symptoms, signs, and disorders should be undertaken particularly in cases of chronic or persistent problems. As there is not scientific consensus on categorization of symptoms, for purposes of discussion, acute symptoms are defined as those presenting for less than 1 month; subacute symptoms, 1–3 months; and chronic symptoms, greater than 3 months.
- Non-physical factors (i.e., psychiatric, psychosocial, workplace, or socioeconomic issues) should be investigated and addressed, particularly in cases of delayed recovery or delayed return to work. These factors are often not overt and specific inquiries are required to identify these issues.

It is important to note that many of these conditions, particularly lateral epicondylalgia or epicondylitis and other tendinoses, tend to resolve spontaneously (e.g., see “wait and see” groups within studies of corticosteroid injections^{9,10}). Thus, in evaluating research studies, including prospective studies, that do not include a placebo control, caution should be exerted as results may be interpreted as showing benefit even when there is not true improvement from the therapy beyond normal spontaneous resolution.

BASIC PRINCIPLES

DEFINITIONS

Inflammation:

A localized protective response elicited by an injury or destruction of tissues, which serves to destroy, dilute, or wall off (sequester) both the injurious agent and the injured tissue. Inflammation is characterized in the acute form by four classical signs: 1) pain (dolor); 2) heat (calor); 3) redness (rubor); and 4) swelling (tumor). Loss of function (functio laesa) may also occur. Histologically, inflammation involves a complex series of events, including dilatation of arterioles, capillaries, and venules, with increased permeability and blood flow; exudation of fluids, including plasma proteins; and leukocytic migration into the inflammatory focus. Classic inflammatory responses are found in infectious diseases. Most musculoskeletal disorders of the elbow only exhibit one of the classic signs of inflammation¹¹—that of pain; therefore, these disorders do not qualify as an acute inflammatory process in which three of the four classical signs must be present.

Tendinitis:

Inflammation within the tendon or tendon insertion with the clinical signs of redness, heat, and swelling accompanied by pain and decreased range of movement. While “tendinitis” is a widely used term diagnostically, there is general supposition that inflammation is present.

Enthesitis:

Inflammation of the muscular or tendinous attachment to bone.

Enthesopathy:

Disorder of the muscular or tendinous attachment to bone.

Epicondylitis:

Inflammation of the lateral or medial epicondyle of the elbow (humerus) from any cause.

Epicondylalgia:

Pain in the epicondyle from any cause. It can be at the origin of a tendon or be referred pain.

Tendinosis:

A chronic degenerative tendon injury, unaccompanied by redness or heat. It is associated with pain and limited movement.¹² Tendinosis may be due to an interaction of individual and physical factors, which may include vocational and avocational activities. In theory, micro-injuries gradually accumulate faster than they can heal and become clinically apparent when the area becomes painful. Tendinosises are the most commonly seen types of elbow musculoskeletal disorders.

The severity of all of these disorders is thought to be influenced by numerous factors, including:

- The person's age, presence of various medical conditions and habits, level of fitness, and general health (chronic tendon degeneration is more common with age).¹³ Poor fitness is theorized to make physical injuries more common.
- The amount of forceful use and lack of recovery time (e.g., hours of work per day, per week, and per month as well as number of breaks per day).^{2,14,15}
- The person's genetics (e.g., a higher initial Type III/Type I collagen ratio in the tendons).
- Potential ergonomic risk factors associated with musculoskeletal disorders (i.e., excessive force, awkward position, repetition, sustained exertion, vibration, improperly fitted tools or sports equipment, or poor technique).^{2,14,15}

VARYING SUSCEPTIBILITY TO TENDINOSES

Individuals seem to vary in their susceptibility to tendinosis. Some people go through their entire lives without ever experiencing tendinosis. Many people experience mild tendon problems, but recover. Others develop chronic tendinosis that is not infrequently attributed to physical exertion. Many individuals develop chronic tendon injuries in multiple places of the body. Usually, a careful medical history will reveal some contributing associated factor(s), but tendon injury occasionally occurs without an obvious cause.

Theoretically, the tendinosis cycle begins when breakdown exceeds repair. One theory is that physical exertion causes micro-injuries that accumulate with time. The tensile strength of collagen is exceeded, and the tendon tries to repair itself, but the cells produce new collagen with an abnormal structure and composition.

The new collagen has an abnormally high Type III/Type I ratio. Experiments have shown that the excess Type III collagen at the expense of Type I collagen weakens the tendon, making it prone to further injury. Part of the problem may be that the new collagen fibers are less organized into the normal parallel structure, making the tendon less able to withstand tensile stress along the direction of the tendon.¹⁶

Therefore, according to this theory, tendinosis is a slow accumulation of minor injuries that are not repaired properly and that leave the tendon vulnerable to additional injury. This failed healing process may be one reason that some people with tendinosis do not completely clinically heal following an injury, and thus encounter difficulties in returning to their previous level of activity. Once the tendinosis cycle starts, the tendon rarely heals back to its pre-injury state.

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

INITIAL ASSESSMENT

Thorough medical and work histories and a focused physical examination (see Chapter 2: General Approach to Initial Assessment and Documentation) are recommended for the initial assessment of elbow symptoms.¹⁷ This evaluation should take into account the possibility that the elbow pain is referred from or due to a disorder in another part of the body, particularly the neck, shoulder, or forearm. Red flags (see Table 1) identified on the history and physical examination raise suspicion of serious elbow disorders.¹⁷ Their absence generally rules out the need for special studies, referral, or inpatient care during the first 4 weeks when spontaneous improvement or recovery is expected. Referral may be needed when there is lack of training in managing the specific entity, uncertainty about the diagnosis or treatment plan, or if red flags are present.

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

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

MEDICAL HISTORY

The medical history is usually the most important aspect in the evaluation of a patient. Many disorders of the elbow will be diagnosable with a high degree of accuracy prior to examination based upon a careful medical history. Of critical importance in the occupational setting is the recording of the patient's report of the mechanism(s) of injury. It is noteworthy that this record is also often critical in subsequent case review. Asking the patient open-ended questions, such as those that follow, allows the physician to gauge the need for further information. Discussion, or more specific inquiries, will usually produce the detail necessary for clinical decision-making. It may be helpful to also use standardized questionnaires such as the DASH (Disabilities of the Arm, Shoulder and Hand)²⁰ outcome measure or the Upper Extremity Function Scale for Upper Extremity Disorders.²¹

Questions that should be asked as part of the examination:

1. What are your symptoms?

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

Table 1. Red Flags for Potentially Serious Elbow Conditions

Disorder	Medical History	Physical Examination
Fractures	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 and not improved with rest	Palpable mass not consistent with usual diagnoses
Inflammation	History of gout or pseudogout History of rheumatoid arthritis History of other inflammatory arthritides	Effusion Localized heat, swelling, erythema, tenderness
Rapidly Progressive Neurologic Deficit	History of neurologic disease Trauma	Abnormal neurologic examination Focal or global motor weakness distal to the elbow Weakness may be limited to one nerve, such as hand intrinsic muscles
Vascular Compromise	History of diabetes mellitus Tobacco use History of fracture or dislocation History of vascular disease of any kind	Decreased or absent peripheral pulses and delayed capillary refill Edema
Compartment Syndrome ^{18, 19}	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

- How did your symptoms start? Was there an event that precipitated the symptoms?
- How do your symptoms limit your work performance?
- Have your symptoms changed? How?

2. How did your condition develop?

PAST:

- Have you had previous similar episodes?
- Have you had previous testing or treatment?
- What treatments did you receive?
- With whom?
- Were the treatments effective?

CAUSE:

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

Job:

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

Off-work activities:

- What are your hobbies (e.g., tennis, golf, etc.)?
- Do you use your elbow to perform these hobbies? How? How often?
- What chores do you perform (e.g., housecleaning, gardening, carpentry, repairs, etc.)?

3. How do these symptoms limit you?

- Which hand do you use to write or use tools?
- Can you flex your elbow to work or accomplish activities of daily living (i.e., brush your teeth, feed yourself, shower/bath, comb your hair, dress yourself)? For how long?
- Do you have trouble turning a doorknob or using a screwdriver (pronation/supination)?
- Can you lift a heavy object? How much weight can you lift?
- Can you carry a shopping bag with handles, heavy purse, or briefcase on the affected side?
- How long have your activities been limited?

4. Do you have other medical problems?

- Do you have any autoimmune, infectious, or metabolic diseases such as rheumatoid arthritis or gout?
- Do you have arthritis in any joints?
- Do you smoke?
- Do you have diabetes or HIV?
- Do you have fibromyalgia, other musculoskeletal problems, or chronic pain?
- Have you ever had cancer?

5. What are your expectations regarding your return to work and disability from this health problem?

6. What are your concerns about the potential for further injury to your elbow as you recover?
7. How do you like your job? Your supervisor and coworkers? What is your relationship with your co-workers and supervisor and how do they treat you?
8. What do you hope to accomplish during this visit?

PHYSICAL EXAMINATION

Guided by the medical history, the physical examination should include:

- General observation of the patient
- Focused examination of the forearm, arm, elbow, and shoulder with discussion of the symptoms
- Neurovascular assessment

Though it may seem too obvious to warrant mention, the physician should specifically note which elbow (left or right) is the subject of the patient's complaints. Injured workers may have prior injuries to the opposite elbow. Ambiguity in documentation can lead to a delay in acceptance of the patient's workers' compensation claim, delay in the authorization of time-loss benefits, delay in the authorization of payment of medical care, or even outright denial of the workers' compensation claim.

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

Subjective Evidence: Symptoms

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

Objective Evidence: Signs

A sign is any objective evidence of a disease. Examples of objective evidence signs include visible changes, swelling, deformity, redness, heat, reflex changes, spasm, palpable changes, atrophy, nonresistant passive range of motion, and imaging findings. Such evidence is perceptible to the examining physician, as opposed to the subjective sensations (symptoms) of the patient.¹¹

Objective evidence should be thoroughly documented in the medical record both for reference during future visits and for relevance to the patient's workers' compensation claim. For most patients with elbow disorders, no truly objective physical examination evidence exists. Therefore, meticulous documentation of the patient's complaints at each visit is of the utmost importance in such cases.

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

ANATOMY

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

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

While there are many muscles and tendons associated with elbow and wrist movement, this chapter will only address those that commonly cause elbow pain or produce referred pain to the elbow.²²

Flexion of the elbow: The main flexors are the biceps brachii, brachialis, and brachioradialis.¹⁷ The long head of the biceps brachii originates on the supraglenoid tuberosity, while the short head originates on the coracoid process and insertions are on the tuberosity of the radius and bicipital aponeurosis to the fascia of the forearm. The brachialis muscle arises from the lower half of the anterior humerus and inserts on the tuberosity and coronoid process of the ulna. The brachioradialis muscle originates on the lateral supracondylar ridge and inserts on the radial styloid. Pertaining to the elbow, other than epicondylalgia, the biceps brachii are most often involved in clinical tendinoses and ruptures.

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

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

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

A. FOCUSED ELBOW EXAMINATION

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

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

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

Palpation is performed on the elbow to ascertain points of tenderness. Palpation is also performed to detect swelling, tumors, osteophytes, and other abnormalities. Individuals with lateral epicondylalgia tend to have

tenderness over the epicondyle proper, the radial head, and/or two centimeters distant to the epicondyle.²¹ Similarly, those with medial epicondylalgia tend to have tenderness either over the epicondyle and/or several centimeters distal.²³

Muscle-strength testing is often helpful. However, weakness in the absence of atrophy is particularly difficult to assess. Pain-limited weakness is common and makes determination of true muscular weakness substantially more difficult. Weakness on the unaffected side should be noted.

Reflexes help to detect abnormalities in nerves, nerve roots, spinal cord, and higher level functioning. Sensory examination of the elbow includes fine touch, two-point discrimination, and vibratory sense and position sense in the distal extremity. For the vast majority of common elbow problems, a full sensory examination is not required. However, when symptoms that could represent a nervous system disorder are present, appropriate examination is necessary.

The physician should generally examine one joint above and below the joint being examined, particularly if symptoms are present elsewhere. Thus, examination of the shoulder and forearm are required. Examination of the neck is also required in many evaluations of the elbow to exclude cervical pathology as it is a common source of patients' elbow complaints.

Special examination maneuvers are performed to help diagnose an elbow disorder.¹⁷

Common maneuvers include:

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

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

B. NEUROVASCULAR SCREENING

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

C. ASSESSING RED FLAGS

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

D. DIFFERENTIAL DIAGNOSES

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. 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.

DIAGNOSTIC CRITERIA

If the patient does not have red flags for serious conditions, the physician can then determine which common musculoskeletal elbow disorder is most likely present. 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, and finally to diagnostic investigation, if needed, to guide treatment at this stage.

1. For each diagnosis, signs, as well as symptoms, are required to fulfill the diagnostic criteria. It is also important to understand the rate of false positives and false negatives for various tests used to confirm the diagnosis.
2. The correct diagnosis guides appropriate diagnostic investigations.
3. The correct diagnosis permits the physician to focus on the most appropriate and effective treatment and avoids approaches using unproven, ineffective, or suboptimal treatments.

Table 2. Diagnostic Criteria for Non-red Flag Elbow Conditions that Can Be Managed by Primary Care Physicians

Probable Diagnosis or Injury	Mechanism	Symptoms	Signs	Test and Results
Contusion ICD-9 923.11 ICD-10 S50.0	Direct blow Fall	Local pain	Range of motion usually normal Soft tissue swelling Ecchymosis	None
Nondisplaced Radial Head Fracture ICD-9 813.05 ICD-10 S52.1	Fall onto outstretched hand Fall onto lateral elbow	Lateral elbow pain Pain on pronation and supination of forearm	Maximal tenderness over radial head Reduced elbow extension when compared with unaffected side	Radiograph evidence of fracture or effusion
Lateral Epicondylalgia/ Epicondylitis/ Tendinosis ICD-9 726.32 ICD-10 M77.1	Possibly related to forceful use of elbow or wrist, repetition and postural factors Some cases related to acute trauma	Pain in lateral elbow [Absence of tingling/numbness] [Absence of neck pain or stiffness]	Tenderness over epicondyle and 2-3 centimeters distal to it over the extensor carpi radialis brevis and extensor digitorum tendons Pain in lateral elbow with resisted extension of wrist or middle finger Pain in the lateral elbow with forceful grasp Normal elbow range of motion Diffuse lateral elbow pain with repeated wrist dorsiflexion	Positive resistance test results: lateral epicondylar area pain with resisted extension of the wrist, middle finger, index finger, and or supination
Medial Epicondylalgia/ Epicondylitis/ Tendinosis ICD-9 726.31 ICD-10 M77.0	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 2-3 centimeters distal to it Pain in medial elbow with resisted wrist or phalangeal flexion Normal elbow range of motion	Positive resistance test results: pain with resisted flexion of the wrist, fingers, and pronation

Table 2. Diagnostic Criteria for Non-red Flag Elbow Conditions that Can Be Managed by Primary Care Physicians (continued)

Probable Diagnosis or Injury	Mechanism	Symptoms	Signs	Test and Results
Ulnar Nerve Entrapment (including Cubital Tunnel Syndrome) ICD-9 354.2 ICD-10 G56.2	<p>Two main categories involving cubital tunnel and condylar groove</p> <p>Etiologies are unclear—there are no quality epidemiological studies</p> <p>Theorized mechanisms include hyperflexion of the elbow or prolonged leaning on the elbows for condylar groove segment neuropathies</p>	<p>Paresthesias in the ring and 5th digits—generally spares dorsal surfaces</p> <p>Pain may or may not be present</p>	<p>Paresthesias in the ring and small fingers on 60 second elbow flexion test</p> <p>Subluxation of the ulnar nerve in the condylar groove sometimes present</p> <p>Weakness/atrophy of ulnar hand intrinsics and interosseous muscles (unusual/late)</p> <p>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</p>	<p>Nerve conduction study with above versus below elbow conduction assessment</p> <p>"Inching technique" may be helpful that documents a focal decrement in a specific ulnar nerve location, although it has not been rigorously examined regarding whether it affects outcomes and a problem is most typically either in the condylar groove or the cubital tunnel segments of the nerve</p> <p>Abnormalities on EMG are later findings typical of more advanced cases</p>
Radial Nerve Entrapment (including Radial Tunnel Syndrome) ICD-9 354.3 ICD-10 G56.3	<p>Etiology is unknown—there are no quality epidemiological studies</p>	<p>Studies of the clinical presentation of this disorder are not well performed—thought to involve aching pain in extensor/supinator area of forearm</p>	<p>Physical examination findings are not well characterized for this disorder</p> <p>Pain on stressing extended middle finger</p> <p>Maximum tenderness four fingerbreadths anterior and inferior to the lateral epicondyle</p> <p>Utility of Hoffman-Tinel's test undetermined</p>	<p>High-quality studies do not exist—some believe nerve conduction velocity decrement are uniformly present and others believe abnormal nerve conduction findings are variably present</p>

Table 2. Diagnostic Criteria for Non-red Flag Elbow Conditions that Can Be Managed by Primary Care Physicians (continued)

Probable Diagnosis or Injury*	Mechanism	Symptoms	Signs	Test and Results
Olecranon Bursitis (noninfectious) ICD-9 726.33, 712.22, 712.32, 274.0, 712.82 ICD-10 M70.2	Prolonged leaning on elbow/chronic pressure Acute trauma Chronic pressure	Swelling of bursa Pain in the bursa generally either absent or minor	Effusion/mass effect in bursa Tenderness over the bursa generally not present or minor Tenderness more likely with complications of inflammatory arthropathy	Monosodium urate acid or uric crystals if gout Calcium pyrophosphate crystals if pseudogout
Olecranon Bursitis (infectious) ICD-9 726.33 ICD-10 M71.1	Trauma with non-intact dermis Introduced infections from injection(s) Systemic infection	Progressive painful swelling of bursa Systemic signs of infection	Erythema, warmth and/or surrounding cellulitis Marked tenderness over bursa	Purulent tap, positive gramstain results, positive culture results Portal of entry for infection
Biceps Tendinosis ICD-9 726.30, 726.39 ICD-10 M77.8	Forceful flexion, particularly near maximal or repeated high force Unaccustomed forceful use	Pain in anterior elbow joint or antecubital fossa	Tenderness on palpation of biceps myotendinous junction	Pain in the biceps insertion area with resisted elbow flexion
Pronator Syndrome ICD-9 354.1 ICD-10 G56.1	Etiology unclear	Pain in proximal forearm with parasthesias in median nerve distribution of the hand	May be tender over pronator muscle	Resisted pronation augments symptoms
Nonspecific Elbow Pain ICD-9 726.39, 719.42 ICD-10 M25.5	Unknown	None	None	None

Note: ICD-9 International Classification of Diseases, 9th ed., and ICD-10 International Statistical Class of Diseases and Related Health Problems, 10th Revision for 2006.

WORK-RELATEDNESS

Symptoms associated with physical tasks commonly involve elbow disorders. A thorough understanding of the work history and patient work and non-work activities can help to determine work-relatedness (see Chapter 2: General Approach to Initial Assessment and Documentation, and Chapter 4: Work-Relatedness, for additional details).

Tendinoses, epicondylalgia, epicondylitis, and olecranon bursitis are sometimes attributed to employment activities. Such a conclusion requires a careful history regarding occupational physical factors, non-work activities, individual or personal factors, and psychosocial, psychiatric, and other risk factors, as well as a thoughtful, careful assessment of the relative contribution each makes to the patient's problem while incorporating epidemiological evidence. However, many conditions have no apparent cause and thus are defined as idiopathic.

Physical factors are currently thought to contribute to regional elbow pain and perhaps epicondylalgia/epicondylitis, although the evidence is not particularly strong.^{2,14} For example, few prospective cohort studies have been reported. In addition, the strength of the association in the reported studies is not great. Current evidence suggests that force, repetition, and duration of exertion may be the most important physical factors contributing to elbow pain.

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

INITIAL CARE

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

The following are treatment recommendations for contusion, olecranon bursitis (aseptic), nondisplaced radial head fracture, dislocation of the elbow, sprain of the elbow, biceps tendinosis, ulnar nerve entrapment, radial nerve entrapment, pronator syndrome, lateral epicondylalgia, and medial epicondylalgia. These treatment modalities may be administered or supervised by a number of health care professionals, including physicians, nurses, physical therapists, occupational therapists, nurse practitioners, physician assistants, etc., according to their legal scope of practice. It should be noted that for treatments of uncertain effectiveness that are free of undue risk and individual and aggregate cost, a therapeutic trial may be appropriate if side effects and effectiveness are carefully followed. The effectiveness of such a trial should be measured by objective findings appropriate for the patient and the intervention, and should be documented accordingly. The trial should be promptly discontinued if it does not result in subjective or functional improvement.

Referral is indicated in cases where the health care provider has a lack of training in managing the specific entity, is uncertain about the diagnosis or treatment plan, or red flags are present. If significant symptoms causing self-limitations or restrictions persist beyond 4–6 weeks, referral for specialty evaluation (e.g., occupational medicine, physical medicine and rehabilitation, or orthopaedic surgery) may be indicated to assist in the confirmation of the provisional diagnosis and to define further clinical management.

CONTUSION

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.¹¹ Medical management of contusions should be directed at maintaining normal elbow function. With significant contusion-related injury, there is a risk of deep tissue involvement, potentially leading to scarring and limitation of motion. Accordingly, treatment should include anti-inflammatory medications with avoidance of immobilization except as necessitated by other injuries. Anti-inflammatory medications serve as an analgesic in the doses that are used for contusions. Early mobilization should also be encouraged to prevent impairment and disability and can be best accomplished through instruction in the initial clinical visit. Medical management can be summarized as protection, rest, ice, compression, elevation, and range-of-motion exercises. Range-of-motion exercises should primarily involve the elbow, but may also include the shoulder and wrist, particularly if a sling is prescribed. Quality studies are not available on the benefits of these treatment options and there is not evidence of their benefits. However, these options are low cost, have few side effects, and are not invasive. Thus, while there is insufficient evidence as to the benefits of these options, they are recommended **[Recommended, Insufficient Evidence (I)]**.

OLECRANON BURSITIS (ASEPTIC)

Olecranon bursitis is a condition associated with a generally painless effusion of the olecranon bursa, frequently caused by either overt or seemingly insignificant trauma over the olecranon. In a minority of cases, it may become infected, at which point pain and tenderness predominate. Quality studies are not available on the following treatment options for olecranon bursitis, and as such, there is not evidence of benefits. However, these options are low cost, have few side effects, and are not invasive. Thus, while there is insufficient evidence, the following treatment options are recommended:

- Soft padding of the elbow which appears successful for most cases **[Recommended, Insufficient Evidence (I)]**; and
- Modifying activities to avoid direct pressure over the olecranon and allowing time to reabsorb the fluid **[Recommended, Insufficient Evidence (I)]**.

Glucocorticoid injection into an uninfected bursa is not recommended for initial management as it may introduce an infection and necessitate surgery; however, it is sometimes used for bursitis that is resistant to other treatment. Therefore, injection of a glucocorticosteroid 3 or more weeks later is neither recommended nor not recommended **[No Recommendation, Insufficient Evidence (I)]**. (See the surgical section for surgical issues, as well as for septic olecranon bursitis.)

NON-DISPLACED RADIAL HEAD FRACTURE

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. An x-ray is required to determine the degree of the fracture and type of treatment required. For the medical management of non-displaced radial head fracture, the physician should prescribe a sling or splint for 7 days. (A shorter complete immobilization period of as little as 3 days may be used for non-displaced fractures that are clinically present but not visible on an x-ray.) After 7 days, gentle range-of-motion exercises within pain tolerance should begin,¹⁷ followed by progressive mobilization. Range-of-motion exercises should primarily involve the elbow, but should also include the shoulder (to prevent frozen shoulder), and the wrist. Limited mobility may be achieved with a sling, cast, or posterior elbow splint wrapped over the joint with a tensor at 90° flexion. A thermoplastic splint with Velcro straps may also be used. As pain diminishes, the

unresistant active movement should be increased to pain tolerance to prevent or minimize contracture. Quality studies are not available on these treatment options and there is not evidence of their benefits. However, these options are low cost, have few side effects, and are not invasive. Thus, while there is insufficient evidence as to the benefits of these options, they are recommended **[Recommended, Insufficient Evidence (I)]**.

DISLOCATION OF THE ELBOW

Dislocation of the elbow generally occurs as a result of significant, high-force trauma, and only dislocation of the shoulder is more common clinically.¹⁷ 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. Radial head fractures are present approximately 10% of the time.

There are no quality studies for treating dislocation of the elbow. An evaluation of the motor, sensory, and vascular system is required. 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 by a health care professional experienced in joint relocation as soon as possible. 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 examination 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. Non-steroidal anti-inflammatory drugs (NSAIDs) are helpful. Quality studies are not available on these treatment options for dislocation of the elbow, and there is not evidence of benefits due to the relatively low incidence combined with the acute traumatic nature of these cases. However, these options are low cost, have few side effects, and are not invasive. Thus, while there is insufficient evidence as to their benefits, these options are recommended **[Recommended, Insufficient Evidence (I)]**.

SPRAIN OF THE ELBOW

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

Pain and limited use of the elbow are typical presenting complaints. There are no quality studies on treating sprains of the elbow. A shoulder sling may be used for up to 1 week. Gentle range-of-motion exercises are recommended to be initiated at the first visit to prevent complications from immobilization, particularly if a sling is prescribed. While range-of-motion exercises should concentrate on the elbow, they should include the shoulder joint to prevent frozen shoulder (adhesive capsulitis) and the wrist as well. NSAIDs are helpful. Quality studies are not available on these treatment options and there is not evidence of their benefits due to the relatively low incidence. However, these options are low cost, have few side effects, and are not invasive. Thus, while there is insufficient evidence supporting their use, these options are recommended **[Recommended, Insufficient Evidence (I)]**.

BICEPS TENDINOSIS

Biceps tendinosis is a true muscle strain involving the muscle-tendon junction of the biceps brachii. 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 limited weakness is a common complaint. In severe cases, the muscle is ruptured and in many working age patients, usually requires surgical repair (see Surgical Considerations).

NSAIDs are helpful. Activity limitations to avoid aggravating exposures are recommended. A sling may be helpful for severe cases, but gentle range-of-motion exercises should be prescribed to avoid contraction. While range-of-motion exercises should concentrate on the elbow, they should include the shoulder joint to prevent frozen shoulder (adhesive capsulitis) and the wrist as well. Therapy with transitioning to strengthening exercises is recommended. Quality studies are not available on treatment options for biceps tendinosis and there is not evidence of benefits due to the low incidence. However, these options are low cost, have few side effects, and are not invasive. Thus, while there is insufficient evidence, they are recommended

[Recommended, Insufficient Evidence (I)].

ULNAR NERVE ENTRAPMENT

(including Cubital Tunnel Syndrome)

Although it is possible to entrap a nerve at any point along its course, there are two main 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. Most of the published literature does not distinguish between these types of ulnar neuropathy despite the improbability that the risk factors and treatments are the same. This produces a substantial lack of clarity in the available evidence.

Proper testing to localize the abnormality involves a nerve conduction study that includes at least stimulation above and below the elbow.²⁴ 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 logical, has not been defined in the evidence.

Aside from surgical studies, there are no quality studies on which to rely for treatment of ulnar neuropathies, and there is not evidence of benefits of the following treatment options. However, these options are low cost, have few side effects, and are not invasive. Thus, while there is insufficient evidence, these treatment options are recommended:

- Elbow padding **[Recommended, Insufficient Evidence (I)]**;
- Avoidance of leaning on the ulnar nerve at the elbow **[Recommended, Insufficient Evidence (I)]**;
- Avoidance of prolonged hyperflexion of the elbow **[Recommended, Insufficient Evidence (I)]**; and
- Although not particularly successful for neuropathic pain, utilization of NSAIDs **[Recommended, Insufficient Evidence (I)]**.

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, 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 30–100 fold less common than carpal tunnel syndrome.²⁵ 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.^{26,27}

A confirmatory electrodiagnostic motor study is helpful, but often difficult to obtain [Recommended, Insufficient Evidence (I)]. There are no quality studies on which to rely for the treatment of radial neuropathies and there is not evidence of benefits of the following treatment options. However, these options are low cost, have few side effects, and are not invasive. Thus, while there is insufficient evidence to support their use, they are recommended:

- Use of a wrist splint for periodic daytime use rather than continuous use [Recommended, Insufficient Evidence (I)]; and
- Although not particularly successful for neuropathic pain, utilization of NSAIDs [Recommended, Insufficient Evidence (I)].

PRONATOR SYNDROME

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, but somewhat difficult to obtain [Recommended, Insufficient Evidence (I)]. There are no quality studies on which to rely for the treatment of pronator syndrome and there is not evidence of benefits of the following treatment options. However, these options are low cost, have few side effects, and are not invasive. Thus, while there is insufficient evidence, the following options are recommended:

- Wrist brace [Recommended, Insufficient Evidence (I)];
- Although not particularly successful for neuropathic pain, utilization of NSAIDs [Recommended, Insufficient Evidence (I)]; and
- Activity modifications should be attempted if felt to be contributory [Recommended, Insufficient Evidence (I)].

LATERAL EPICONDYLALGIA

(Lateral Epicondylitis)

Lateral epicondylalgia (lateral epicondylitis) causes soreness, or pain on the outside (lateral) side of the upper arm near the elbow. There may be a partial tear of the tendon fibers, which connect muscle to bone, at or near their point of origin on the outside of the elbow.

INITIAL CARE

Comfort is often a patient’s primary concern. In employment settings, where milder cases are more frequently seen, nonprescription analgesics may provide sufficient pain relief for most patients with acute and subacute elbow symptoms. Patients in clinical settings may be more severe and may require prescription analgesics as first line treatments. If the treatment response is inadequate, such that symptoms and activity limitations continue, prescribed pharmaceuticals, orthotics, or physical methods can be added. Comorbid conditions, side effects, cost, and provider and patient preferences should guide the health care professional’s choice of

recommendations. Table 3 summarizes options for lateral epicondylalgia. Conservative care often consists of activity modification using epicondylalgia supports (tennis elbow bands), and NSAIDs with standard precautions on potential side effects.

Table 3. Methods of Symptom Control for Lateral Epicondylalgia

RECOMMENDED
Nonprescription Medications
Acetaminophen—safest and may be effective when taken regularly (I) Aspirin (I) Ibuprofen (B)
Prescribed Pharmaceutical Medications
Oral NSAIDs (B) Topical NSAIDs (B) Local corticosteroid injection—1 mL triamcinolone (10 mg/mL) of bupivacaine with a 25 or 27 gauge needle—for short-term benefit after 3–4 weeks of conservative treatment (B)
Physical Rehabilitation Interventions
Adjustment or modification of workstation, job tasks, job rotation, breaks, or work hours and methods, if needed (I) Specific elbow exercises for range of motion and, if needed, strengthening (I) Aerobic exercise to maintain general conditioning (I) Initial and follow-up visits for education, counseling, and evaluation of home exercise (I) At-home local applications of cold packs during first few days of acute symptoms; thereafter application of heat packs, or cold packs as the patient prefers (I) <i>Note: It is not believed to be useful to simultaneously treat a patient with more than 2–3 modalities.</i>
Physical Modalities
Tennis elbow band (I) Ultrasound treatment—pulsed ratio of 1:4 and duration of 2 ms or continuous—at a frequency of 0.7–1.5 MHz, an intensity of 1.0–2.0 W/cm ² , for 5–10 minutes, over a 5 cm ² treatment area, 2–3 times per week based on objective results up to 5–6 weeks (B) Iontophoresis—40mA-minutes, total of 6–10 treatments, with either glucocorticoid or diclofenac (C) Acupuncture (I)

*** Strength of Evidence Ratings:**

A = **Strong evidence-base:** One or more well-conducted systematic reviews or meta-analysis, or two or more high-quality studies.

B = **Moderate evidence-base:** At least one high-quality study, a well-conducted systematic review or meta-analysis of lower quality studies, or multiple lower-quality studies relevant to the topic and the working population.

C = **Limited evidence-base:** At least one study of intermediate quality.

I = **Insufficient evidence:** Evidence is insufficient or irreconcilable.

MEDICATIONS

Acetaminophen: There is no evidence evaluating the effects of acetaminophen in treating epicondylalgia. However, acetaminophen may provide enough mild analgesic relief to allow the patient to exercise or function at a higher level. Quality studies are not available on acetaminophen, and there is not evidence of its treatment benefits. However, it is low cost, has few side effects, and is not invasive. Thus, while there is insufficient evidence, acetaminophen is recommended [**Recommended, Insufficient Evidence (I)**].

Oral NSAIDs: One intermediate-quality study (patients with symptoms of 10 or less days) was reviewed that randomized **flurbiprofen** vs. **piroxicam**²⁸ and found that “flurbiprofen was significantly superior to piroxicam with regard to relief of pain at day 28, pain on active movement at days 14 and 28, pain on passive movement at days 7, 14 and 28 and pain, as measured by a visual analogue scale, at day 14.” Two low-quality studies evaluated **diflunisal** and **naproxen**. The first found no significant differences between the groups (patients with symptoms for at least 6 or 7 days prior to evaluation) and therefore, concluded that diflunisal and naproxen are “equivalent in providing relief of pain and tenderness due to tennis elbow.”²⁹ The second study (patients’ duration of symptoms not indicated) concluded that “diflunisal and naproxen significantly reduce pain...however, diflunisal provided more effective pain relief in the group studied.”³⁰ Lastly, one high-quality study (43.3% of patients had symptoms for less than 6 weeks and 44.1% had symptoms for more than 6 months) evaluated **diclofenac** (150 mg) versus placebo, with the results indicating that a “statistically and clinically significant reduction of pain was associated with diclofenac, but no clinically significant difference in grip strength or functional improvement could be detected between the 2 groups.”³¹ The authors concluded that it is “difficult to recommend the use of diclofenac in the treatment of lateral epicondylalgia at the dosage used in this study.”

In conclusion, there is some evidence that NSAIDs result in improvements. There also is some weak, preliminary evidence suggesting that all NSAIDs may not be equally efficacious for lateral epicondylalgia. Evidence suggests that piroxicam is inferior to other NSAIDs for the treatment of lateral epicondylalgia, and thus should not be either the first- or second-line treatment. Quality studies are available on NSAIDs including acute (less than 1 month), subacute (1-3 months), and chronic (more than 3 months) lateral epicondylalgia patients and there is evidence of its benefits. Effects are dose dependent and caution should be used with higher doses primarily due to gastrointestinal side effects. Overall, these options are low cost, have few side effects, and are not invasive. Thus, NSAIDs are recommended as a treatment option **[Moderately Recommended, Evidence (B)]**.

Aspirin: There is no evidence evaluating the effects of aspirin in treating epicondylalgia. However, aspirin may provide enough mild analgesic relief to allow a patient to exercise or function at a higher level. Quality studies are not available on aspirin and there is not evidence of its benefits. However, this option is low cost, has few side effects, and is not invasive. Thus, while there is insufficient evidence supporting its use, aspirin is recommended as a treatment option **[Recommended, Insufficient Evidence (I)]**.

Topical NSAIDs and Other Agents: One intermediate-quality study was reviewed that reported on a **flurbiprofen** local-action transcutaneous (LAT) patch versus **piroxicam** gel (patients’ duration of symptoms not indicated). Results found that “flurbiprofen LAT had a greater efficacy than piroxicam gel, and was also preferred by patients in the treatment of painful soft-tissue rheumatism of the shoulder and elbow.”³² An intermediate-quality study (patients’ duration of symptoms not indicated) examined transdermal electromotive drug administration of **ketorolac** vs. placebo (normal saline) and found that “poor results (no improvement) were significantly higher in the placebo-treated group, while good results were significantly higher in the ketorolac-treated group.”³³ Another intermediate-quality study (patients’ duration of symptoms not indicated) examined the effectiveness of **naproxen** applied by topical iontophoresis or by phonophoresis and found that “iontophoresis and phonophoresis of naproxen are equally effective electrotherapy methods in the treatment of lateral epicondylitis.”³⁴

Two intermediate-quality studies examined topical use of **diclofenac** for lateral epicondylalgia. One study (patients with symptom duration of 2 months; average of 8.3 months) found that “topical 2% diclofenac in pluronic lecithin liposomal organo-gel (PLO) appears to provide effective short-term reduction in elbow pain and wrist extensor weakness associated with chronic lateral epicondylitis.”³⁵ The second study (patients with onset of symptoms less than 4 weeks) concluded that there was a “statistically significant gradually increasing clinical improvement in patients treated with diclofenac gel as compared with the control group, as well as good tolerability of the drug in the treatment of soft-tissue rheumatism.”³⁶ A low-quality study (duration of injury was no more than 5 days for sprains and no more than 12 days for tendinitis) compared piroxicam gel and diclofenac topical gel in the treatment of acute sprains and tendinitis of the ankle, shoulder, or elbow and

found “no difference in the response to treatment or in the global impressions of efficacy between piroxicam and diclofenac.”³⁷ Therefore, the authors concluded that “piroxicam 0.5% gel and diclofenac 1.16% gel are equally effective and well tolerated in the treatment of selected acute sprains and tendinitis.” Lastly, an intermediate-quality study evaluated diclofenac epolamine (DHEP) lecithin gel versus placebo gel (patients pain had been present for less than 5 days).³⁸ The results indicated that “DHEP lecithin gel is a topically effective analgesic product in patients with shoulder periartthritis or lateral epicondylitis and provide further evidence on the use of topical nonsteroidal anti-inflammatory drugs as an optimal approach to the treatment of localized musculoskeletal disorders.” There are no studies evaluating other agents, including ketamine gel. Several studies that were reviewed that compared either two topical NSAIDs or a topical NSAID and a placebo showed that there is some evidence of improvement when using topical NSAIDs for the treatment of lateral epicondylalgia. Evidence suggests that piroxicam is inferior to other NSAIDs for the treatment of lateral epicondylalgia, and thus should not be either a first- or second-line treatment. There are no studies comparing topical agents with oral NSAIDs. Quality studies are available on topical NSAIDs including acute, subacute and chronic lateral epicondylalgia patients and there is evidence of benefits. This option is low cost, has few side effects, and is not invasive. Thus, topical NSAIDs are recommended as a treatment option **[Moderately Recommended, Evidence (B)]**.

Narcotics: There are no quality studies evaluating opioids in the treatment of lateral epicondylalgia. Opioids cause significant side effects, which include poor patient tolerance, constipation, drowsiness, clouded judgment, memory loss, and potential misuse or dependence has been reported in up to 35% of patients. Patients should be informed of these potential side effects and cautioned against operating motor vehicles or machinery before prescribing opioids. Opioids do not appear to be more effective than safer analgesics for managing most musculoskeletal symptoms; they should be used only if needed for severe pain and only for a short time. Opioids in an acute elbow injury or inflammation with redness, heat and swelling, may be used concurrently with an anti-inflammatory, ice, and rest and tapered off after 2 to 3 days. In a subacute or chronic situation, they are limited to concurrent use with an exercise program and then tapered off over several days to 2 weeks, as strength and endurance improve. No use beyond this time is recommended regardless of the outcome. Quality studies are not available on narcotics and there is not evidence of their benefits. This option is low cost, is not invasive, but has many significant side effects. Thus, narcotics are not recommended **[Not Recommended, Insufficient Evidence (I)]** except as outlined above.

INJECTIONS

Corticosteroid injections: Twelve articles on corticosteroid injections for lateral epicondylalgia were reviewed, including 10 studies^{9,10,39,40,41,42,43,44,45,46} and two meta-analysis.^{47,48} One of the studies was of high quality, seven of intermediate quality, and two of low quality. Evidence consistently demonstrates that steroid injections into the vicinity of the lateral epicondyle produce short-term pain relief more effectively than do either physical therapy or a “wait and see” approach. However, in the long term, steroid injections are less effective in providing pain relief than is physical therapy or a “wait and see” approach.^{9,10,47,48} One study compared a “wait and see” approach (one visit with a family doctor during which the patients were encouraged “to await further spontaneous improvement” and possible recommendation for the use of acetaminophen or an oral non-steroidal anti-inflammatory medication) with corticosteroid injections (into “every tender spot...until the patient was free of pain during resisted dorsiflexion”) and physical therapy (9 treatments of pulsed ultrasound, deep friction massage and an exercise program) over a 6 week intervention period.⁹ The patients included in this study had pain for at least 6 weeks duration with a median duration of 11 weeks in the three groups. Initially, steroid injections were the most successful form of treatment. By 12 weeks, however, the success rates of “wait and see” and physical therapy exceeded those of steroid injections. There was no statistically significant benefit of physical therapy over “wait and see.” Another study (patients with symptoms for less than 4 weeks) compared the addition of steroid injections in the vicinity of the lateral epicondyle to similarly performed sham injections, in randomly selected groups of patients receiving rehabilitation treatment.⁴³ There was no significant difference in outcome

between the two groups at baseline, 4 weeks, 8 weeks, and 6 months. Both groups had a nearly significant ($p=0.06$) improvement in the mean from baseline to 4 weeks, 8 weeks, and 6 months for all 5 pain scales. From 8 weeks to 6 months, there was a significant improvement in the Visual Analog Scale (VAS) pain scores for the group receiving the corticosteroid injections ($p = 0.04$), but not in the group receiving the sham injections.

This intervention was assessed in acute, subacute, and chronic lateral epicondylalgia patients. Overall, the studies show clear short-term benefits, yet high recurrence rates among injection groups. The level of pain several weeks after injection generally approaches that of the natural history of resolution of the disorder; thus injections (e.g., 1 mL triamcinolone [10 mg/mL] with a 25 or 27 gauge needle) are recommended for short term benefit to reduce the overall magnitude of pain in select cases. In most cases, physicians should carry out conservative measures (i.e., NSAIDs, orthotics, other non-interventional measures) for 4–6 weeks before considering injections. Generally, there is an inclination to not use more than approximately 3 glucocorticoid injections in any one location for one episode. However, there is no evidence that there is or is not a limit on the number of injections either for an episode or for a lifetime. Subsequent injections should be supported by either objective improvement or utilization of a different technique or location for the injection(s). If symptom relief is obtained, then a proven graduated exercise program for strength and endurance should be considered to maintain and enhance that improvement. It should be noted that glucocorticoid injections have some risks. For example, with a large volume in a small space there is a risk of tendon fraying and even rupture, although the underlying pathogenesis is thought to frequently entail those processes. Injections can also cause an inflammatory reaction causing pain lasting for several hours, and rarely infection.

There is good evidence that glucocorticoid injections reduce lateral epicondylar pain. However, there is also good evidence that the recurrence rates are high. On the other hand, pain at the time of recurrence is generally not as severe. Thus, despite the problems with recurrence, there is support for utilizing corticosteroid injections in select cases to help decrease overall pain problems during the disorders' natural recovery or improvement phase. Quality studies are available on glucocorticoid injections and there is evidence of short-term benefits, but not long-term benefits. This option is invasive, but is low cost and has few side effects. Thus, if a non-invasive treatment strategy fails to improve the condition over a period of at least 3–4 weeks, glucocorticoid injections are recommended [**Moderately Recommended, Evidence (B)**].

One study used corticosteroid injections combined with either **lidocaine** or **bupivacaine** (average symptom duration was 7.9 months in one group and 9.1 months in the other group). The author concluded that the "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."⁴⁶ Quality studies are available on the use of bupivacaine as an adjuvant for glucocorticoid injections, and there is some evidence of short-term benefits that are superior to lidocaine. This option is invasive, but is low cost and has few side effects. Thus, bupivacaine, as an adjuvant for glucocorticoid injections, is recommended [**Recommended, Evidence (C)**].

Botulinum injections: Botulinum injections were evaluated for treatment of lateral epicondylalgia in three studies, one of intermediate quality and two of high quality. An industry-sponsored, multicenter double-blind, randomized-controlled clinical trial of botulinum A versus placebo for treatment of epicondylalgia lasting at least 4 months and failing at least three other interventions found both groups improved significantly over the 4-month follow-up period.⁴⁹ There was no difference at any point in the maximum pain scores, but other pain measures were different. At week 18, the pain score (composed of 5 different physical examination maneuvers) had fallen in the botulinum group from 8.4 ± 0.2 to 2.9 ± 0.4 while the controls dropped from 8.6 ± 0.2 to 4.3 ± 0.4 ($p = 0.009$). Another study evaluated 60 patients who had pain for at least 3 months (30 received a botulinum toxin injection and 30 received a placebo) and found that "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 extension."⁵⁰ However, a study which evaluated 40 patients with symptoms for more than 6 months (19 received botulinum toxin injection and 21 received normal saline solution) did not find a significant difference between the two groups studied and therefore, no evidence

of benefit from botulinum toxin injection was found.⁵¹ Quality studies of chronic lateral epicondylalgia patients are available on botulinum injections, but the available studies conflict on whether these injections are beneficial. This option is invasive, has side effects, and is high cost. Thus, there is no recommendation for botulinum injections **[No Recommendation, Insufficient Evidence (I)]**.

Autologous blood injections: There are no quality studies of autologous blood injections for lateral epicondylalgia. Quality studies are not available on autologous blood injections and there is not evidence of its benefits. This option while low cost, is invasive and has side effects. Thus, autologous blood injections are not recommended **[Not Recommended, Insufficient Evidence (I)]**.

PHYSICAL METHODS

There are a variety of physical methods which may be appropriate to use in the treatment of lateral epicondylalgia. However, as reviewed below, there is evidence of efficacy for certain methods, no evidence for several others, and evidence of a lack of efficacy for some. Published randomized controlled trials (RCTs) are needed to provide better evidence for the use of many physical interventions that are commonly employed. Some providers use a variety of procedures; yet conclusions regarding their effectiveness are not based on high-quality studies. Included among these interventions are epicondylalgia supports, exercise, heat/cold packs, manipulation, massage, friction massage, soft tissue mobilization, biofeedback, transcutaneous electrical neurostimulation (TENS), electrical stimulation (E-STIM), magnets, diathermy, and acupuncture.

The therapist should document objective evidence of functional improvement in order to justify continued care. This can be demonstrated by a combination of clinical improvement in disability questionnaires (e.g., DASH or Upper Extremity Function Scale), improvement in pain-free grip strength, or improvement in lifting ability, or some other functional activity (i.e., the therapist should be evaluating the patient's performance of an activity found to be limited at the time of the initial evaluation). Instead of focusing on a specific number of visits/treatment duration, identifying trends in the treatment provided are likely to be more helpful:

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

PHYSICAL TREATMENT METHODS AVAILABLE INCLUDE:

- **Epicondylalgia Supports (Tennis Elbow Bands, Braces or Epicondylitis Straps):** Eleven articles were reviewed on orthotics for epicondylalgia, five studies^{52,53,54,55,56} and six meta analysis.^{57,58,59,60,61,62} Three of the studies were of intermediate quality and two were of low quality. One study examined a sample of 63 patients with symptoms for 6 weeks or longer in which 30 received treatment with the dynamic extensor brace and 33 received no brace for 12 weeks (there was a crossover period from weeks 12–24, where the no brace group received treatment with the brace).⁵³ The results of the study showed that “12 weeks

of brace treatment results in relief of pain, improvement in functionality of the arm, and pain-free grip strength in patients with lateral epicondylitis. The beneficial effects last for at least another 12 weeks after cessation of the brace therapy.” Another study evaluated 180 patients (with symptoms for at least 6 weeks) treating them with either physical therapy (n = 56), an Epipoint brace (n = 68) or combination of physical therapy and brace treatment (n = 56).⁵⁴ As the physical therapy regimen was not specified, the results are uninterpretable. The authors concluded that “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 [6 weeks].” Quality studies are available on epicondylalgia supports in acute, subacute, and chronic lateral epicondylalgia patients, although the braces most commonly used in research studies are not widely used in the US. There is evidence of benefits. However, these options are low cost, have few side effects, and are not invasive. Thus, while there is insufficient evidence to support their use, they are recommended **[Recommended, Insufficient Evidence (I)]**.

- Instruction in home exercise.** Eleven articles were reviewed, eight studies^{9,10,43,54,63,64,65,66} and three meta-analysis,^{47,48,62} none of which had a control group, some had small numbers of subjects and none had an isolated experimental group of exercise only. Comparisons of exercise techniques used across studies are difficult and limit interpretation. Co-interventions were very common, further limiting interpretation. One study was high quality, six were intermediate and one was low quality. One of the reviews evaluated 28 studies and suggested that exercise may improve pain, but not grip strength, in lateral epicondylalgia. Except for cases of unstable fractures or acute dislocations, it is recommended that physicians advise patients to do early range-of-motion exercises at home. Range-of-motion exercises should primarily involve the elbow, but should also include the shoulder and the wrist. Instruction in proper exercise technique is important, and a few visits to a physical therapist can serve to educate the patient about an effective exercise program. Quality studies are available on exercise programs in acute, subacute, and chronic lateral epicondylalgia patients, although there are many differences between the exercise programs used in research studies and thus comparisons between studies are difficult. There is not good evidence for any one specific exercise strategy. Benefits have not been clearly shown. However, these options are low cost (as single time instructions), have few side effects, and are not invasive. Thus, while there is insufficient evidence, instruction in home exercise is recommended **[Recommended, Insufficient Evidence (I)]**. In the event that the patient is either incapable of performing home exercises, or otherwise unable to comply with this option, then a supervised program with a therapist is recommended **[Recommended, Insufficient Evidence (I)]**.
- Heat or Cold Packs.** One study of intermediate quality of subacute and chronic lateral epicondylalgia patients was reviewed. It included 40 patients with symptoms for at least 4 weeks (duration of symptoms was approximately 4 months in the group studied). The study provided evidence that the application of ice following exercise does not improve pain relief over exercise alone.⁶⁷ Only one quality study is available on cryotherapy and none on heat. Benefits have not been shown. These options are low cost (as at-home applications), have few side effects, and are not invasive. Thus, while there is insufficient evidence, at-home applications of heat or cold packs are recommended **[Recommended, Insufficient Evidence (I)]**.
- Iontophoresis.** Three studies were reviewed, all of intermediate quality. One study was a device manufacturer-funded study that included 199 patients with symptoms of 3 months or less.⁶⁸ There appeared to be an initial improvement in symptoms with iontophoresis. However, it was not sustained by the 1 month follow-up. One study evaluated 64 patients with pain for at least 1 month, but had a 33% dropout rate.⁶⁹ There were no statistically significant differences between the iontophoresis steroid group and the iontophoresis placebo group. All subjects (experimental and control) improved with time. The last study included 40 patients (mean duration of pain was 5.2 months in one group and 4.8 months in the second group), was nonblinded with no placebo group, and performed in Turkey with equipment not available in the US.⁷⁰ The results from this study “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.” In conclusion, there is some evidence for short-term efficacy of iontophoresis (40 mA-minutes, total of 6–10 treatments with either glucocorticoid or diclofenac) for lateral epicondylalgia. Six treatments are appropriate for acute cases and 10 treatments for chronic cases, as long as the patient is showing functional improvement. Quality studies are available on iontophoresis in subacute and chronic lateral epicondylalgia patients and benefits have been shown. This option is moderately costly, has few side effects, and is not invasive. Thus, iontophoresis is recommended **[Recommended, Evidence (C)]**.

- **Ultrasound.** Twelve articles were reviewed, seven studies^{65,71,72,73,74,75,76} and five meta analysis.^{47,48,62,77,78} One study was of high quality, four of intermediate quality, and one of low quality. Some of the studies had no placebo/control group or sham arm.^{65,71,72} However, two studies were triple blinded (patient, physician/assessor, therapist).^{73,75} The first study had three arms—ultrasound, sham ultrasound, and control (rest) group and a large sample of 99 patients with 33 in each group.⁷³ Patients had pain for at least 1 month. The second study had two arms—pulsed ultrasound and sham ultrasound and a large sample of 76 patients with 38 in each group.⁷⁵ Patients also had pain for at least 1 month. Both of these studies showed significant improvement over rest and sham respectively. Two more studies (one with a sample of 55 patients with pain of at least 6 weeks duration⁷⁴ and another with a sample of 45 patients with pain for at least 1 month⁷⁶) did not show statistically significant differences between pulsed ultrasound (one used low-dose ultrasound⁷⁴) and sham ultrasound with respect to treatment effect. Another study treated 39 patients (30 had symptoms for over 3 months and 9 for over 1 year) with either a four-step home exercise program or pulsed ultrasound and showed statistically significant differences demonstrating a positive benefit for exercise.⁶⁵ Finally, one review of 23 RCTs “showed weak evidence for the effectiveness of US [ultrasound] in comparison with placebo” but “insufficient evidence in favor of US [ultrasound] when compared to other active interventions,”⁷⁷ while another review of 38 RCTs and controlled clinical trials (n = 6 for lateral epicondylalgia) concluded that “the inconsistent results of these high quality studies indicate weak evidence in favor of the ultrasound therapy (proportion of positive studies, 33%)” for lateral epicondylalgia.⁷⁸ In conclusion, there is evidence for short-term efficacy with ultrasound (pulsed ratio of 1:4 and duration of 2 ms or continuous at a frequency of 0.7–1.5 MHz, an intensity of 1.0–2.0 W/cm², for 5–10 minutes, over a 5 cm² treatment area, 2–3 times per week based on objective results up to 5–6 weeks). Quality studies are available on ultrasound in acute, subacute, and chronic lateral epicondylalgia patients and benefits have been shown. This option is moderately costly, has few side effects, and is not invasive, although it does not appear to result in large improvements. Thus, ultrasound is recommended **[Moderately Recommended, Evidence (B)]**.
- **Manipulation.** For manipulation, four articles were reviewed (three intermediate-quality studies and one meta-analysis). One study evaluated 28 patients (with symptoms for at least 6 weeks and not more than 6 months duration) receiving manipulation of the wrist by a physical therapist to test its impact on lateral epicondylalgia pain (palpation and resisted extension).⁷⁹ However, this small study did not have adequate statistical power to permit meaningful conclusion. Another study recruited 13 subjects (mean duration of symptoms of 16.6 weeks in one group and 12.5 weeks in the second group) and concluded that ultrasound was more effective than manipulation.⁸⁰ The third study (198 patients with pain of at least 6 weeks duration) showed combinations of exercise and mobilization was superior to corticosteroid injections, but was not superior to a “wait-and-see” approach at 52 weeks.¹⁰ There was no ability to separate out effects of the exercises and mobilization as there were many different interventions apparently incorporated in the single study. The meta-analysis indicated that “there are no long term studies of adequate methodological quality on manual therapy.”⁶² Quality studies are available on manipulation in subacute and chronic lateral epicondylalgia patients, but the available studies conflict on whether it is beneficial. This option is moderately costly, has few side effects, and is not invasive. Thus, there is no recommendation for using manipulation **[No Recommendation, Insufficient Evidence (I)]**.

- **Massage.** There are no quality studies of massage for lateral epicondylalgia. Quality studies are not available on massage and benefits have not been shown. This option is moderately costly, has few side effects, and is not invasive. Thus, there is no recommendation for using massage [**No Recommendation, Insufficient Evidence (I)**].
- **Friction Massage.** Seven articles were reviewed, four studies and three meta-analysis.^{47,48,62} Three of the studies were of intermediate quality and one was of low quality. None of the studies evaluated friction massage alone. One study evaluated corticosteroid injections, physiotherapy (which included friction massage) and a “wait and see” approach⁹; one studied physical therapy (which included friction massage), brace-only, and brace plus physical therapy⁵⁴; one study examined ultrasound plus placebo, ultrasound plus friction massage, phonophoresis, and phonophoresis plus friction massage⁸¹; and the final study looked at Cyriax physiotherapy (which included friction massage), supervised exercise program, and biopton light.⁶⁴ This intervention was assessed in subacute and chronic lateral epicondylalgia patients. Quality studies are not available on friction massage and benefits have not been shown. This option is moderately costly, has few side effects, and is not invasive. Thus, there is no recommendation for using friction massage [**No Recommendation, Insufficient Evidence (I)**].
- **Magnets.** There are no quality studies for using magnets to treat lateral epicondylalgia. Quality studies are not available on magnets and benefits have not been shown. This option is low cost, has few side effects, and is not invasive. Thus, there is no recommendation for using magnets [**No Recommendation, Insufficient Evidence (I)**].
- **Extracorporeal Shockwave Therapy.** Twelve articles were reviewed, 10 studies^{82,83,84,85,86,87,88,89,90,91} and two meta-analyses.^{62,92} Of the 10 studies, two were of high quality, five of intermediate quality and three of low quality. One of the high-quality studies⁸² evaluated 60 subjects with symptoms for less than 1 year and more than 3 weeks, treating them with either active extracorporeal shockwave therapy (ESWT) with a simple stretching program (n = 31) or sham ESWT with a simple stretching program (n = 29). The authors concluded that “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.” The second high-quality study evaluated 272 patients with at least 6 months of conservative treatment (135 received ESWT and 137 received placebo ESWT) and found that ESWT as “applied in the present study was ineffective in the treatment of lateral epicondylitis.”⁸⁵ One of the meta-analysis reviewed two studies, concluding “no added benefit of ESWT over that of placebo in the treatment of LE [lateral epicondylitis].”⁶² The other review analyzed nine studies (the studies reviewed above) and concluded that “when data were pooled, most benefits were not statistically significant. No difference for participants early or late in the course of condition.”⁹² Quality studies are available on extracorporeal shockwave therapy in acute, subacute, and chronic lateral epicondylalgia patients and benefits have not been shown. This option is moderately costly, has some short-term side effects, and is not invasive. Thus, there is a recommendation against using extracorporeal shockwave therapy [**Strongly Not Recommended, Evidence (A)**].
- **Phonophoresis.** Three studies were reviewed, two of intermediate quality and one of low quality. Two of the studies had small sample sizes (61 and 49 participants, respectively), and no placebo control.^{34,72} One of these studies also had a heterogeneous population with 69% having symptoms for longer than 3 months (they were evaluating phonophoresis versus ultrasound in multiple body locations), thus the sample size for those with lateral epicondylalgia had low statistical power.⁷² The third study (patients with a mean duration of symptoms of 2.1, 4.3, 5.2, and 5.4 months) also did not have a complete placebo control and the small sample size (n = 40) limited statistical power.⁸¹ Results showed no statistically significant differences among the various experimental groups. Quality studies are available on phonophoresis in subacute and chronic lateral epicondylalgia patients and benefits

have not been shown. This option is moderately costly, has few side effects, and is not invasive. Thus, there is a recommendation against using phonophoresis [**Not Recommended, Evidence (C)**].

- **Low-Level Laser Therapy.** Ten articles were reviewed, eight studies^{93,94,95,96,97,98,99,100} and two meta analysis.^{62,101} Three of the studies were of high quality, four of intermediate quality, and one of low quality. The types of laser and the techniques used varied throughout the studies. Two studies included some patients with medial epicondylalgia; the remainder limited their subjects to those with lateral pain. Treatment sessions were 3–5 per week for 3 to 10 weeks. Only one study of 49 patients (median duration of pain of 12 months in the laser group and 7 months in the placebo group) demonstrated a very limited benefit of low-level laser treatment versus placebo.⁹⁹ One study of 30 patients (average duration of symptoms for 3.6 months) found that low-level laser compared similarly with physiotherapy (deep friction massage and pulsed ultrasound).¹⁰⁰ A second study of 30 patients (average duration of symptoms of 4.1 months in the laser group and 2.9 months in the placebo group) concluded that low-level laser was somewhat more effective than placebo, but was of “limited value” in treatment.⁹⁶ On the other hand, two studies (one looked at 49 patients with a median duration of pain of 6 months and the other looked at 36 patients with duration of symptoms ranging from 4–52 weeks) found no benefit of low-level laser in treating epicondylalgia.^{93,95} One of the meta-analysis⁶² found “no evidence of effect over that of a placebo intervention in either the short or long term.” The other pooled study also found “poor results” for effectiveness and the authors concluded that “optimal treatment dose has obviously not yet have been discovered.”¹⁰¹ These varied studies can be generalized to state that there is no evidence for the effectiveness of low-level laser therapy in medial or lateral elbow pain. Quality studies are available for low-level laser therapy in acute, subacute, and chronic lateral epicondylalgia patients and benefits have not been shown. This option is moderately costly, has few side effects, and is not invasive. Thus, there is a recommendation against using low-level laser therapy [**Strongly Not Recommended, Evidence (A)**].
- **Acupuncture.** Twelve studies were reviewed on acupuncture, six studies^{93,102,103,104,105,106} (two used the same population) and six meta-analysis.^{48,62,107,108,109,110} All of the studies were of intermediate quality. One study evaluated 48 patients with pain of at least 2 months (average of 15.4 months) and treated them with either a single acupuncture treatment or a placebo and concluded that “non-segmental verum acupuncture has an intrinsic analgesic effect in the clinical treatment of tennis elbow pain which exceeds that of placebo acupuncture.”¹⁰² A second study treated 45 patients (duration of symptoms greater than 3 months) with either real acupuncture or sham acupuncture and found that 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.”^{103,104} One of the meta-analysis found that “all the studies suggested that acupuncture was effective in the short-term relief of lateral epicondylar pain. Five of six studies indicated that acupuncture treatment was more effective compared to a control treatment. There is strong evidence suggesting that acupuncture is effective in the short-term relief of lateral epicondyle pain.”¹⁰⁸ Another review concluded that there “appears to be some evidence to support the efficacy of acupuncture over a placebo as a treatment for LE [lateral epicondylitis] in short term outcomes. However, this benefit appears to be short lived—that is, two to eight weeks.”⁶² On the other hand, a third meta-analysis concluded that there is “insufficient evidence to either support or refute the use of acupuncture (either needle or laser) in the treatment of lateral elbow pain.”¹⁰⁷ In conclusion, acupuncture—needling at depths of 1.25–2.5 cm for 20–25 minutes, 2–3 times a week for a total of 6 treatments—may be appropriate for an initial trial of therapy for the treatment of lateral epicondylalgia, with an additional 6 if there is evidence of objective functional improvement. Quality studies are available on acupuncture in subacute and chronic lateral epicondylalgia patients and short-term benefits have been shown. This option is moderately costly, is invasive, but has few side effects. Thus, there is a recommendation for the short-term use of use of acupuncture [**Recommended, Insufficient Evidence (I)**].

In addition, there are no quality studies available for the following interventions for lateral epicondylalgia and benefits have not been shown. These options are moderately costly, have few side effects, and are not invasive.

Thus, there is no recommendation for them.

- Soft Tissue Mobilization [No Recommendation, Insufficient Evidence (I)]
- Biofeedback [No Recommendation, Insufficient Evidence (I)]
- Transcutaneous Electrical Nerve Stimulation (TENS) [No Recommendation, Insufficient Evidence (I)]
- Electrical Stimulation (E-Stim) [No Recommendation, Insufficient Evidence (I)]
- Diathermy [No Recommendation, Insufficient Evidence (I)]

MEDIAL EPICONDYLALGIA

(Medial Epicondylitis)

Medial epicondylalgia is much less common than lateral epicondylalgia, which is thought to be about seven times more common. Medial epicondylalgia is sometimes thought to occur concomitantly with ulnar neuropathy at the elbow. Treatment of medial epicondylalgia is inferred from the treatment of lateral epicondylalgia. While the evidence is unclear if this is appropriate, it is assumed by the medical community that this is correct. Therefore, it is recommended that the guidelines for lateral epicondylalgia be utilized by inference for medial epicondylalgia.

There is some evidence to support this supposition, as iontophoresis for medial epicondylalgia⁶⁸ [Recommended, Evidence (C)] and glucocorticosteroid injections appear to have the same benefits and time course for efficacy for both disorders. For example, one high-quality study of corticosteroid injections for medial epicondylalgia was reviewed.¹¹¹ In this study, 60 elbows (58 patients with a mean duration of symptoms of 4.33 ± 0.25 months in the experimental group and 4.72 ± 0.25 months in the control group) were randomized into two groups of 30. Both groups were managed with NSAIDs and physical therapy that was provided in the same physical therapy department with “very similar protocols.” Additionally, one group received an injection of 1 cc of 1% lidocaine and 1 cc of methylprednisolone, 40 mg; the other group received an injection of 1 cc of 1% lidocaine and 1 cc of 0.9% saline. At 6 weeks post-injection, the group receiving the steroid injection experienced significantly less pain than the control group. There were no significant differences in the mean scores of the two groups at 3 months or at 1 year. Quality studies are available on glucocorticoid injections in chronic medial epicondylalgia patients and there is evidence of short-term, but not long-term benefits. This option is invasive, but is low cost and has few side effects. Thus, glucocorticoid injections are recommended [Moderately Recommended, Evidence (B)].

ACTIVITY MODIFICATION FOR ELBOW DISORDERS

There are no studies regarding the efficacy of activity modifications, including workplace restrictions, and no studies demonstrating that activity modifications alter the clinical course. Still, it is widely believed that some activities may materially aggravate and perpetuate symptoms of lateral epicondylalgia. Quality studies are not available on activity modifications and benefits have not been shown. This option is moderately costly, but is not invasive and has few side effects. Thus, activity modifications are recommended if needed [Recommended, Insufficient Evidence (I)].

Careful advice regarding maximizing activities within the limits of symptoms is believed to be important. Activities that increase stress on the wrist's extensor mechanism, which originates at the elbow, tend to aggravate symptoms. Consequently, consideration may be given to restrictions on forceful use, lifting, and repetitive flexion or extension following the onset of epicondylalgia.

Workstation modifications to reduce the force on the elbow are believed to be important in resolving the problem in cases where the occupational tasks materially contribute. Understanding the worksite and the employer's willingness to and the feasibility of modifying the workstation may be important to maintain the employee at work and/or minimize disability time. Quality studies are not available on workstation modifications and benefits have not been shown. This option is moderately costly, but is not invasive and has few side effects. Thus, workstation modifications are recommended if needed [**Recommended, Insufficient Evidence (I)**].

For each diagnosis/medical condition, return-to-work (RTW) criteria are needed. For most conditions, while restrictions may be needed, there is not a need for time away from work. Typically, lateral epicondylalgia does not require time off work, nor do other elbow-related musculoskeletal disorders. However, for those who require time away from work, the physician needs to determine the best timing for the employee to return-to-work. The physician also needs to determine what accommodations, modifications, or assistive devices if any, are required during functional restoration that will allow an employee to return to the essential tasks of their job or alternative work, and will allow them to return to their activities of daily living. For each diagnosis and severity level, the physician must determine the optimal set of work restrictions, if any are indicated. These job modifications, accommodations, or assistive devices should be based on objective findings, either obtained through a physical examination (resistive strength, range of motion) or other formal evaluation. Restrictions should be written in biomechanical terms, such as lifting up to 30 lbs., and not vague language such as "light duty." It is the employer's responsibility, not the physician's, to send the employee home if he or she is unable to meet the suggested guidelines for restricted duty. Patients should be informed that the restrictions also apply outside of work.

FOLLOW-UP VISITS

A patient with potentially work-related elbow disorders should have follow-up visits based on the acuity and severity of his or her condition. For example, initial follow-up every 4–7 days by a physician may be needed to counsel the patient about avoiding aggravating exposures, medication use, activity modification, and other concerns. Physicians should take care to answer questions and make these sessions interactive so that the patient is involved in his or her recovery. If the patient has returned to work and is progressing, these interactions may be done on site or by telephone to avoid interfering with modified or full-work activities.

Follow-up should occur when a release to modified, increase or full duty is needed, or after appreciable healing or recovery can be expected. Follow-up might be expected every 4–7 days if the patient is off work and every 7–14 days if the patient is working. After 4–6 weeks, follow-up every 2–3 weeks may be needed until full recovery.

SPECIAL STUDIES AND DIAGNOSTIC AND TREATMENT CONSIDERATIONS

Criteria for ordering imaging studies are:

- The imaging study results will substantially change the treatment plan.
- Emergence of a red flag.
- Failure to progress in a rehabilitation program, evidence of significant tissue insult or neurological dysfunction that has been shown to be correctable by invasive treatment, and agreement by the patient to undergo invasive treatment if the presence of the correctable lesion is confirmed.

For most patients presenting with elbow problems, special studies are not needed unless a period of at least 4 weeks of conservative care and observation fails to improve their symptoms. Most patients improve quickly,

provided red flag conditions are ruled out. There are a few exceptions to the rule to avoid special studies absent red flags in the first month. These exceptions include:

- Plain-film radiography to rule out osteomyelitis or joint effusion in cases of significant septic olecranon bursitis.
- Electromyography (EMG) study if cervical radiculopathy is suspected as a cause of lateral arm pain, and that condition has been present for at least 6 weeks.
- Nerve conduction study and possibly EMG if severe nerve entrapment is suspected on the basis of physical examination, denervation atrophy is likely, and there is a failure to respond to conservative treatment.

For patients with limitations of activity after 4 weeks and unexplained physical findings such as effusion or localized pain (especially following exercise), imaging may be indicated to clarify the diagnosis and revise the treatment strategy if appropriate. Imaging findings should be correlated with physical findings.

In general, an imaging study may be an appropriate consideration for a patient whose limitations due to consistent symptoms have persisted for 1 month or more, as in the following cases:

- When surgery is being considered for a specific anatomic defect.
- To further evaluate potentially serious pathology, such as a possible tumor, when the clinical examination suggests the diagnosis.

CHRONIC PAIN CONSIDERATIONS

Chronic elbow pain may occur as a localized musculoskeletal disorder as part of a systematic pain condition or in combination (see Chapter 6: Chronic Pain for detailed discussion on chronic pain). An accurate diagnosis is critical, thus revisiting the diagnosis is highly important as noted above. In patients with long-lasting or recurrent pain but without evidence that there is another specific diagnosis (e.g., radiculopathy), a careful search for widespread pain is particularly indicated as patients frequently fail to mention other symptoms when focusing on the area that seems to be most affected. This evaluation should especially include queries regarding pain and discomfort in the distal upper extremities, shoulders, neck, periscapular areas, and low back. Physical examination maneuvers should particularly include ranges of motion of those joints, qualitative muscle strength testing (e.g., supraspinatus testing, power grasp), as well as ascertainment of pain on palpation of muscles, tendons, and ligaments in these body regions, as well as over bony landmarks and other structures not anticipated to be tender. Anxiety and depressive conditions, as well as somatoform disorders, are believed to be risk factors, and such conditions need not have been previously recognized. Thus, inquiries for psychological and psychiatric issues and administration of questionnaires (e.g., Zung Self-Rating Depression Scale, Modified Somatic Perception Questionnaire, Fear Avoidance Behavior Questionnaire, Oswestry Disability Index¹¹²)* are also indicated. Those with positive findings of non-localized pain, non-localized tenderness, and psychological or psychiatric issues, have relative, but not absolute, contraindications to invasive testing or procedures.

Many of the studies included in the review of interventions in this chapter included patients with chronic pain of more than 3 months duration. Thus, many of these treatments have evidence-based treatment recommendations in chronic elbow pain patients.

* Some of these instruments are available online including the Oswestry Disability Questionnaire (<http://www.everesttherapeutics.com/forms/oswestry.pdf>) and the Zung Self-Rating Depression Scale (<http://healthnet.umassmed.edu/mhealth/ZungSelfRatedDepressionScale.pdf>).

SURGICAL CONSIDERATIONS

The timing of a referral for surgery should be consistent with the condition that has been diagnosed, the degree of functional impairment, and the progression and severity of objective findings. Conditions that produce objective evidence of nerve entrapment and that do not respond to non-surgical treatment can be considered for surgery when treatment failure has been documented, in spite of compliance with treatment. 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. Referral for surgical **consultation** may be indicated for patients who have:

- Significant limitations of activity for more than 3 months;
- Failed to improve with exercise programs to increase range of motion and strength of the musculature around the elbow; or
- Clear clinical **and** electrophysiologic or imaging evidence of a lesion that has been shown to benefit in both the short and long term from surgical repair.

Emergency consultation is reserved for patients who require drainage or aspiration of acute septic effusions, ruptures (e.g., biceps), infected hematomas and/or drainage of infected bursitis, or who have severe acute nerve impingement.

Surgery during the first 3 months is only rarely indicated for elbow disorders that present for initial treatment. If surgery is a consideration, counseling regarding likely outcomes, risks, and benefits, and especially expectations is very 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”).

A. SURGICAL CONSIDERATIONS FOR LATERAL EPICONDYLALGIA

There is currently a debate regarding whether lateral epicondylalgia is an inflammatory condition or an enthesopathy and what treatments are most appropriate. Conservative care should be maintained for a minimum of 3–6 months. Although some individuals will improve with surgery for lateral epicondylalgia, at this time there are no published RCTs that indicate that surgery improves the condition over non-surgical options. There are clinical trials to compare different surgical techniques, but this type of study cannot show the benefit of surgical intervention over medical treatment or untreated controls, particularly when numerous studies have documented the tendency for the condition to spontaneously improve over time.

Five articles were reviewed on surgery for lateral epicondylalgia, four studies^{113,114,115,116} and one meta-analysis.¹¹⁷ One of the studies was of high quality, one of intermediate quality, and two of low quality. The studies evaluated the following techniques: 1) botulinum toxin injections versus open surgery; 2) percutaneous versus open surgery; 3) lengthening of the distal tendon of the extensor carpi radialis brevis (ECRB) surgery versus decompression of the posterior interosseous nerve (PIN) surgery; and 4) open surgery with drilling versus open surgery with no drilling. The first study evaluated 40 patients with an average duration of symptoms of 10.5 months—half were treated with the open (Hohmann) surgical technique and half with botulinum toxin injections.¹¹³ The authors found that “treating chronic tennis elbow with botulinum toxin equal those of operative release.” The second study evaluated 47 elbows (45 patients who had undergone conservative treatment for 12 months); 24 were treated with a formal open release (Nirschl) surgical technique and 23 with a percutaneous surgical technique.¹¹⁴ The results showed that “those patients undergoing a percutaneous release returned to work on average three weeks earlier and improved significantly more quickly than those undergoing an open procedure. The percutaneous procedure is a quicker and simpler procedure to undertake and produces significantly better results.” Another study evaluated 28 elbows (26 patients with average duration of symptoms of 23 months);

half were treated with decompression of the posterior interosseous nerve (PIN) surgery and half with lengthening of the distal tendon of the extensor carpi radialis brevis (ECRB) surgery.¹¹⁵ The authors found that the “overall outcome after a mean follow-up of 31 months after the primary operation was successful in 60% of the cases.” They concluded that 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, can be considered a very effective treatment in chronic tennis elbow.” The last study evaluated 23 elbows (duration of patients symptoms not indicated) and treated them with open (Nirschl) release surgery with drilling or without drilling.¹¹⁶ The author concluded that “drilling confers no benefit and actually causes more pain, stiffness, and wound bleeding than not drilling.” Quality studies are available on surgery for patients with chronic symptoms of lateral epicondylalgia, although they used different surgical techniques and did not include an observation group. Benefits of less invasive procedures are suggested. This option is high cost, invasive, and has moderate side effects. Thus, surgery for lateral epicondylalgia should only be a consideration for those patients who fail to improve after a minimum of 6 months of care that includes at least 3–4 different types of conservative treatment. However, there are unusual circumstances in which, after 3 months of failed conservative treatment, surgery may be considered **[Recommended, Insufficient Evidence (I)]**.

B. MEDIAL EPICONDYLALGIA

Quality studies are not available on surgery for medial epicondylalgia. As noted previously, it is recommended that treatment for medial epicondylalgia be inferred from lateral epicondylalgia; however, some anecdotal information suggests surgical outcomes for medial epicondylalgia may be somewhat worse. This option is high cost, invasive, and has moderate side effects. Thus, surgery for medial epicondylalgia should only be a consideration for those patients who fail to improve after a minimum of 6 months of care that includes at least 3–4 different types of conservative treatment. However, there are unusual circumstances in which, after 3 months of failed conservative treatment, surgery may be considered **[Recommended, Insufficient Evidence (I)]**.

C. ULNAR NERVE ENTRAPMENT

Five studies were reviewed for ulnar nerve decompression surgery^{118,119,120,121,122}; all of intermediate quality. All the studies compared surgical techniques. None incorporated a group receiving physical therapy or non-intervention as a control. Also, none of the studies distinguished between the different types of ulnar neuropathies at the elbow. Two studies^{118,119} compared a simple decompression procedure with anterior subcutaneous transposition of the ulnar nerve (one did not indicate duration of patients’ symptoms and the other included patients with symptoms for greater than 3 months); two studies^{121,122} (one did not indicate duration of patients’ symptoms and the other had a mean duration of symptoms of 27 months in one group and 24.9 months in the second group) compared a simple decompression with submuscular transposition; and one study¹²⁰ compared medial epicondylectomy with anterior transposition with 52 patients who had symptoms of at least 3 months. Unfortunately, the more risky and less effective transposition procedures remain the most common. Evidence is lacking that any of these surgeries has advantages over conservative treatment. The simple ulnar nerve release does have some evidence of benefits over more complicated surgical procedures such as transposition.

Surgery for ulnar nerve entrapment requires establishing a firm diagnosis on the basis of clear clinical evidence and positive electrical studies that correlate with clinical findings. A decision to operate requires significant loss of function, as reflected in significant activity limitations due to the nerve entrapment and that the patient has failed conservative care, including full compliance in therapy, use of elbow pads, removing opportunities to rest the elbow on the ulnar groove, workstation changes (if applicable), and avoiding nerve irritation at night by preventing prolonged elbow flexion while sleeping. Before proceeding with surgery, patients must be apprised of all possible complications, including wound infections, anesthetic complications, nerve damage, and the high possibility that surgery will not relieve symptoms. Absent findings of severe neuropathy such as muscle wasting, at least 3–6 months of conservative care should precede a decision to operate.

Simple Decompression

Quality studies^{118,119,121,122} of patients with chronic ulnar neuropathy at the elbow are available on surgical treatment for ulnar nerve entrapment at the elbow. Surgical options for this problem are high cost, invasive, and have side effects. Yet, in well defined but infrequent cases as outlined above that include positive electrodiagnostic studies with objective evidence of loss of function, lack of improvement may necessitate surgery and surgery for this condition is recommended. Compared with more complex procedures, there is evidence of benefits from simple decompression and this procedure is recommended **[Recommended, Evidence (C)]**.

Submuscular Transposition

Quality studies^{121,122} are available on submuscular transposition. Submuscular transposition has not been shown to be beneficial. This surgical option for this problem is high cost, invasive, and has side effects. Thus, submuscular transposition is not recommended **[Not Recommended, Evidence (C)]**.

Anterior Transposition

Quality studies^{118,119,120} are available on anterior transposition for chronic ulnar nerve entrapment at the elbow. Studies show that while effective, the complication rate is higher than for simple decompression. Surgical options for this problem are high cost, invasive, and have side effects. Yet, in well-defined but infrequent cases that include positive electrodiagnostic studies with objective evidence of loss of function where at time of attempted decompression, indications are felt to be present necessitating anterior transposition, this may be a reasonable option. Thus, subject to these caveats, anterior transposition is recommended **[Recommended, Insufficient Evidence (I)]**.

Medial Epicondylectomy

There is one quality study¹²⁰ of chronic ulnar neuropathy at the elbow available that evaluates anterior transposition vs. medial epicondylectomy. Neither surgery was clearly beneficial; however, there was less pain in the group treated with medial epicondylectomy. This surgical option for this problem is high cost, invasive, has side effects, and may not address the neuropathy. Thus, medial epicondylectomy for ulnar neuropathy is not recommended **[Not Recommended, Insufficient Evidence (I)]**.

D. RADIAL NERVE ENTRAPMENT (INCLUDING RADIAL TUNNEL SYNDROME)

Surgery for radial nerve entrapment requires establishing a firm diagnosis on the basis of clear clinical evidence. Positive electrical studies that correlate with clinical findings should be present. A decision to operate requires significant loss of function, as reflected in significant activity limitations due to the nerve entrapment and that the patient has failed conservative care, including full compliance in therapy, and workstation changes (if applicable). Before proceeding with surgery, patients must be apprised of all possible complications, including the extent of the incision, wound infections, anesthetic complications, nerve damage, and the high possibility that surgery will not relieve symptoms. Absent findings of severe neuropathy such as muscle wasting, at least 3–6 months of conservative care should precede a decision to operate.

Quality studies are not available on surgical treatment for radial nerve entrapment and there is not evidence of its benefits. If, after at least 3–6 months of conservative treatment, the patient fails to show signs of improvement, surgery may be a reasonable option if there is unequivocal evidence of radial tunnel syndrome that includes positive electrodiagnostic studies and objective evidence of loss of function as outlined above. Surgical options for this problem are high cost, invasive, and have side effects. Yet, lack of improvement may in infrequent circumstances necessitate surgery and surgery for this condition is recommended **[Recommended, Insufficient Evidence (I)]**.

E. PRONATOR SYNDROME

Surgery for pronator syndrome requires establishing a firm diagnosis on the basis of clear clinical evidence. Positive electrical studies that correlate with clinical findings should be present. A decision to operate requires significant loss of function, as reflected in significant activity limitations due to the nerve entrapment and that the patient has failed conservative care, including full compliance in therapy, and workstation changes (if applicable). Before proceeding with surgery, the patient must be apprised of all possible complications, including the extent of the incision, wound infections, anesthetic complications, nerve damage, and the possibility that surgery will not relieve symptoms. Absent findings of severe neuropathy such as muscle wasting, at least 3–6 months of conservative care should precede a decision to operate.

Quality studies are not available on surgical treatment for pronator syndrome and there is not evidence of its benefits. If after at least 3–6 months of conservative treatment the patient fails to show signs of improvement, surgery may be a reasonable option if there is unequivocal evidence of pronator syndrome that includes positive electrodiagnostic studies and objective evidence of loss of function as outlined above. Surgical options for this problem are high cost, invasive, and have side effects. Yet, lack of improvement may in infrequent circumstances necessitate surgery; thus, surgery for this condition is recommended **[Recommended, Insufficient Evidence (I)]**.

F. BICEPS RUPTURE

Biceps tendinosis may be severe enough to involve a biceps rupture. This generally occurs in the setting of supramaximal use of force and requires surgical repair in most employed patients. (It is important to note that this recommendation is for a biceps tendon rupture, not a bicipital tendon rupture, which occurs in the bicipital groove at the shoulder and often does not require surgery.) Quality studies are not available on surgery for biceps ruptures and there is not evidence of benefits due to the low incidence and severity of these issues. However, while surgery is high cost, invasive, and has some potential for side effects, outcomes appear much better with surgery as this muscle is the main forearm flexor. Thus, while there is insufficient evidence, surgery for a ruptured biceps is recommended **[Recommended, Insufficient Evidence (I)]**.

G. OLECRANON BURSITIS (ASEPTIC)

Aseptic (uninfected) olecranon bursitis generally resolves without the need for surgery. Quality studies are not available on surgical treatment for aseptic olecranon bursitis and there is not evidence of its benefits. If after at least 6 weeks of conservative treatment the patient fails to show signs of improvement, surgery may be reasonable. Surgical options for this problem are high cost, invasive, and may have more side effects for this condition than continued conservative care. Yet, lack of improvement may in rare circumstances necessitate surgery; thus, surgery for this condition is recommended **[Recommended, Insufficient Evidence (I)]**.

H. OLECRANON BURSITIS (SEPTIC)

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. Signs include swelling, pain, tenderness, and pain on range of motion. Quality studies are not available on this subject and there is not evidence of its benefits; however, septic olecranon bursitis (especially if loculated) usually requires surgical drainage. Surgical options are high cost, invasive, but surgical outcomes have few side effects for this condition. Thus, while there is insufficient evidence, surgery for this condition is recommended **[Recommended, Insufficient Evidence (I)]**. During the recovery phase, treatment options are the same as those for aseptic olecranon bursitis with the additional treatment of antibiotics that are required from the time the condition is recognized as an infection **[Recommended, Insufficient Evidence (I)]**.

SUMMARY OF GUIDELINE RECOMMENDATIONS

Recommendations are made under the following categories:

- Strongly Recommended, “A” Level
- Moderately Recommended, “B” Level
- Recommended, “C” Level
- Insufficient—Recommended (Consensus-based), “I” Level
- Insufficient—No Recommendation (Consensus-based), “I” Level
- Insufficient—Not Recommended (Consensus-based), “I” Level
- Not Recommended, “C” Level
- Moderately Not Recommended, “B” Level
- Strongly Not Recommended, “A” Level

Table 4. Summary of Recommendations for Evaluating and Managing Elbow Disorders

Clinical Measure	Treatment with Evidence Rating/Recommendation Level		
	Recommended	No Recommendation	Not Recommended
History/Physical Exam	Occupational and non-occupational activity history (C) Basic history and exam—search for red flags for tumor, infection, systemic disease (I)		
Patient Education	Patient education regarding diagnosis, prognosis, expectations of treatment and return to work (I)		
Medication	Oral NSAIDs ^{28, 29, 30, 31} (B) Topical NSAIDs ^{32, 33, 34, 35, 36, 37, 38} (B) Acetaminophen (I) Aspirin (I) Ketamine gel for neuropathic pain (I) NSAIDs for ulnar neuropathies (I) Systemic antibiotics and aspiration /drainage for infected bursa (I)		Opioids are not recommended for routine use. However, they may be used in an acute elbow injury or inflammation with redness, heat, swelling concurrently with an anti-inflammatory, ice, and rest and tapered off after 2 to 3 days (I)
Physical Treatment Methods	Ultrasound treatment for epicondylalgia ^{47, 48, 62, 65, 71, 72, 73, 74, 75, 76, 77, 78} (B) Iontophoresis for epicondylalgia with either glucocorticoid or diclofenac ^{68, 69, 70} (C) At-home applications of heat or cold packs for comfort (I) Acupuncture for epicondylalgia (I)	Manipulation (I) Massage (I) Friction massage (I) Soft tissue mobilization (I) TENS (I) Biofeedback (I) Electrical stimulation (I) Magnets (I) Diathermy (I)	Extracorporeal shock wave therapy ^{62, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92} (A) Low-level laser therapy ^{62, 93, 94, 95, 96, 97, 98, 99, 100, 101} (A) Phonophoresis ^{34, 72, 81} (C)

Table 4. Summary of Recommendations for Evaluating/Managing Elbow Disorders (continued)

Clinical Measure	Treatment with Evidence Rating/Recommendation Level		
	Recommended	No Recommendation	Not Recommended
Injections	<p>Local corticosteroid injections for medial and lateral epicondylalgia have evidence of short term efficacy while simultaneously having demonstrated no long-term efficacy. Should only be considered after 3-4 weeks of conservative treatment has failed.^{9, 10, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48} (B)</p> <p>Bupivacaine is superior to lidocaine when combined with corticosteroid in lateral epicondylar injections⁴⁶ (C)</p>	<p>Corticosteroid injection into olecranon bursa only after failure of initial care (I)</p> <p>Botulinum toxin injection for lateral epicondylalgia (I)</p>	Autologous blood injection (I)
Orthotics and Immobilization	<p>Protection, rest, ice, compression, elevation, and mobilization for contusion (I)</p> <p>Limited (i.e., sling or posterior elbow splint) and then early mobilization for non-displaced radial head fracture (I)</p> <p>Epicondylalgia supports for epicondylalgia (I)</p> <p>Dynamic extensor brace for lateral epicondylalgia (I)</p> <p>Wrist splinting for epicondylalgia (I)</p> <p>Wrist splinting for radial tunnel syndrome (I)</p> <p>Nocturnal elbow splinting for ulnar neuropathy (I)</p> <p>Daytime padding for ulnar neuropathies at the elbow (I)</p> <p>Avoidance of leaning on the ulnar nerve at the elbow for ulnar neuropathies (I)</p> <p>Avoidance of prolonged hyperflexion of the elbow for ulnar neuropathies (I)</p> <p>Padding the elbow for sterile effusion of the olecranon bursa (I)</p> <p>Posterior splint for elbow dislocation (I)</p> <p>Shoulder sling for elbow sprain (I)</p> <p>Wrist brace for pronator syndrome (I)</p>		Trial of casting for severe recalcitrant epicondylalgia (I)

Table 4. Summary of Recommendations for Evaluating/Managing Elbow Disorders (continued)

Clinical Measure	Treatment with Evidence Rating/Recommendation Level		
	Recommended	No Recommendation	Not Recommended
Activity/Exercise	Exercise instruction by a therapist for epicondylalgia (I) Physician recommendations for range-of-motion instruction and strengthening exercises in epicondylalgia patients (I) Stretching (I) Aerobic exercise (I) Activity modification (I) Workstation modifications (I)		
Detection of Neurological Abnormalities	NCS to confirm ulnar nerve entrapment if conservative treatment fails (I) NCS to distinguish radial entrapment from lateral epicondylalgia if history and physical exam are equivocal and conservative treatment fails (I)		
Radiography/ Other Imaging Studies	MRI for suspected ulnar collateral ligament tears (C) Plain-film radiography for red-flag cases (I)		Repeat plain-film radiography for readings with "fat pad sign" (I) MRI for suspected epicondylalgia (I)
Surgical Considerations	Simple decompression for ulnar nerve entrapment ^{118,119,121,122} (C) Simple ulnar nerve release for patients with significant activity limitation and delayed NCS (C) Anterior transposition for ulnar nerve entrapment in patients with significant activity limitation and delayed NCS or failed simple release (I) Excision for infected olecranon bursitis if not responsive to IV antibiotics, aspiration and drainage (I) Radial tunnel decompression for failure of conservative treatment and positive electrodiagnostic studies (I) Debridement of inflammatory or scarred tissue for patients with epicondylalgia if conservative treatment fails (I) Surgery for biceps rupture (I) Surgery after at least 6 months of conservative treatment with failure to show signs of improvement (at least 3 months in unusual circumstances) (I)		Submuscular transposition of the ulnar nerve at the elbow ^{121,122} (C) Excision of olecranon bursa due to metabolic arthritis before appropriate medical treatment (I) Medial epicondylectomy for ulnar neuropathy (I) Ulnar nerve surgery in the presence of normal electrical studies (I)

Table 5. Summary of Recommendations by Elbow Disorder

Elbow Disorder	Treatment with Evidence Rating/Recommendation Level		
	Recommended	No Recommendation	Not Recommended
Contusion	Protection, rest, ice, compression, elevation, and mobilization (I)		
Olecranon Bursitis (Aseptic)	Soft padding of the elbow (I) Modifying activities to avoid direct pressure over the olecranon (I) Surgery if after at least 6 weeks of conservative treatment with failure to show signs of improvement (I)	Corticosteroid injection for persistent symptoms (I)	Corticosteroid injection as part of initial care (I)
Olecranon Bursitis (Septic)	Elbow passing (I) Avoid direct pressure (I) Aspiration and antibiotics (I) Surgery (I)		
Non-displaced Radial Head Fracture	Sling/splint for 7 days followed by gentle range of motion exercises then progressive mobilization. Range-of-motion exercises should involve the elbow, but also the shoulder and wrist. A shorter immobilization period of as little as 3 days may be used for nondisplaced fractures that are clinically present but not visible on x-ray. (I)		
Dislocation of the Elbow	Post-reduction x-rays and examination necessary (I) Posterior splint for 10 days (I) Range-of-motion exercises after immobilization. Range-of-motion exercises should involve the elbow, but also the shoulder and wrist. (I) NSAIDs (I)		
Sprain of the Elbow	NSAIDs (I) Shoulder sling may be used for up to 1 week (I) Gentle range-of-motion exercises of the elbow, but including the shoulder and wrist (I)		
Biceps Tendinosis	Sling for severe cases with gentle range-of-motion exercises of the elbow, but including the shoulder and wrist (I) NSAIDs (I) Activity Limitations (I)		

Table 5. Summary of Recommendations by Elbow Disorder (continued)

Elbow Disorder	Treatment with Evidence Rating/Recommendation Level		
	Recommended	No Recommendation	Not Recommended
Ulnar Nerve Entrapment (including Cubital Tunnel Syndrome)	Avoid prolonged hyperflexion of elbow (I) Elbow padding (I) Avoid leaning on elbow (I) NSAIDs (I) Simple decompression ^{118, 119, 121, 122} (C) Anterior transposition after 3–6 months (rare cases) (I)		Submuscular transposition ^{121, 122} (C) Medial epicondylectomy for ulnar neuropathy (I)
Radial Nerve Entrapment (including Radial Tunnel Syndrome)	NSAIDs (I) Confirmatory electrodiagnostic study helpful (I) Wrist splint for periodic daytime use (I) Surgery after at least 6 months of conservative treatment with failure to show signs of improvement (at least 3 months in unusual circumstances) (I)		
Pronator Syndrome	NSAIDs (I) Activity modifications (I) Confirmatory electrodiagnostic study helpful (I) Wrist brace (I) Surgery after at least 6 months of conservative treatment with failure to show signs of improvement (at least 3 months in unusual circumstances) (I)		
Lateral Epicondylalgia (Lateral Epicondylitis)	Acetaminophen (I) Aspirin (I) Heat or cold packs (I) Topical NSAIDs ^{32,33,34,35,36,37,38} (B) Oral NSAIDs ^{28, 29, 30, 31} (B) Home exercise (I) Epicondylalgia supports (I) Activity modification (I) Workstation modifications (I) Ultrasound ^{47,48,62,65,71,72,73,74,75,76,77,78} (B) Iontophoresis ^{68,69,70} (C) Acupuncture (I) Cortisone with bupivacaine ⁴⁶ (C) Local corticosteroid injections ^{9,10,39,40,41,42,43,44,45,46,47,48} (B)	Botulinum toxin injection (I) Massage (I) Friction massage (I) Soft tissue mobilization (I) Biofeedback (I) TENS (I) Electrical stimulation (I) Magnets (I) Diathermy (I) Manipulation (I)	Extracorporeal shock wave therapy ^{62,82,83,84,85,86,87,88,89,90,91,92} (A) Low level laser therapy ^{96,97,98,99,100,101} (A) Phonophoresis ^{34,72,81} (C) Autologous blood injections (I) Opioids (other than acute, severe conditions) (I)

Table 5. Summary of Recommendations by Elbow Disorder *(continued)*

Elbow Disorder	Treatment with Evidence Rating/Recommendation Level		
	Recommended	No Recommendation	Not Recommended
Lateral Epicondylalgia (Lateral Epicondylitis) <i>(continued)</i>	Surgery after at least 6 months of conservative treatment with failure to show signs of improvement (at least 3 months in unusual circumstances) (I)		
Medial Epicondylalgia (Medial Epicondylitis)	Same recommendations as lateral epicondylalgia above Activity modification (I) Workstation modification (I) Iontophoresis ⁶⁸ (C) Corticosteroid injections ¹¹¹ (B) Surgery after at least 6 months of conservative treatment with failure to show signs of improvement (at least 3 months in unusual circumstances) (I)	Same recommendations as lateral epicondylalgia above	Same recommendations as lateral epicondylalgia above
Biceps Rupture	Surgery (I)		

*** Strength of Evidence Ratings:**

A = **Strong evidence-base:** One or more well-conducted systematic reviews or meta-analysis, or two or more high-quality studies.*

B = **Moderate evidence-base:** At least one high-quality study, a well-conducted systematic review or meta-analysis of lower quality studies, ** or multiple lower quality studies relevant to the topic and the working population.

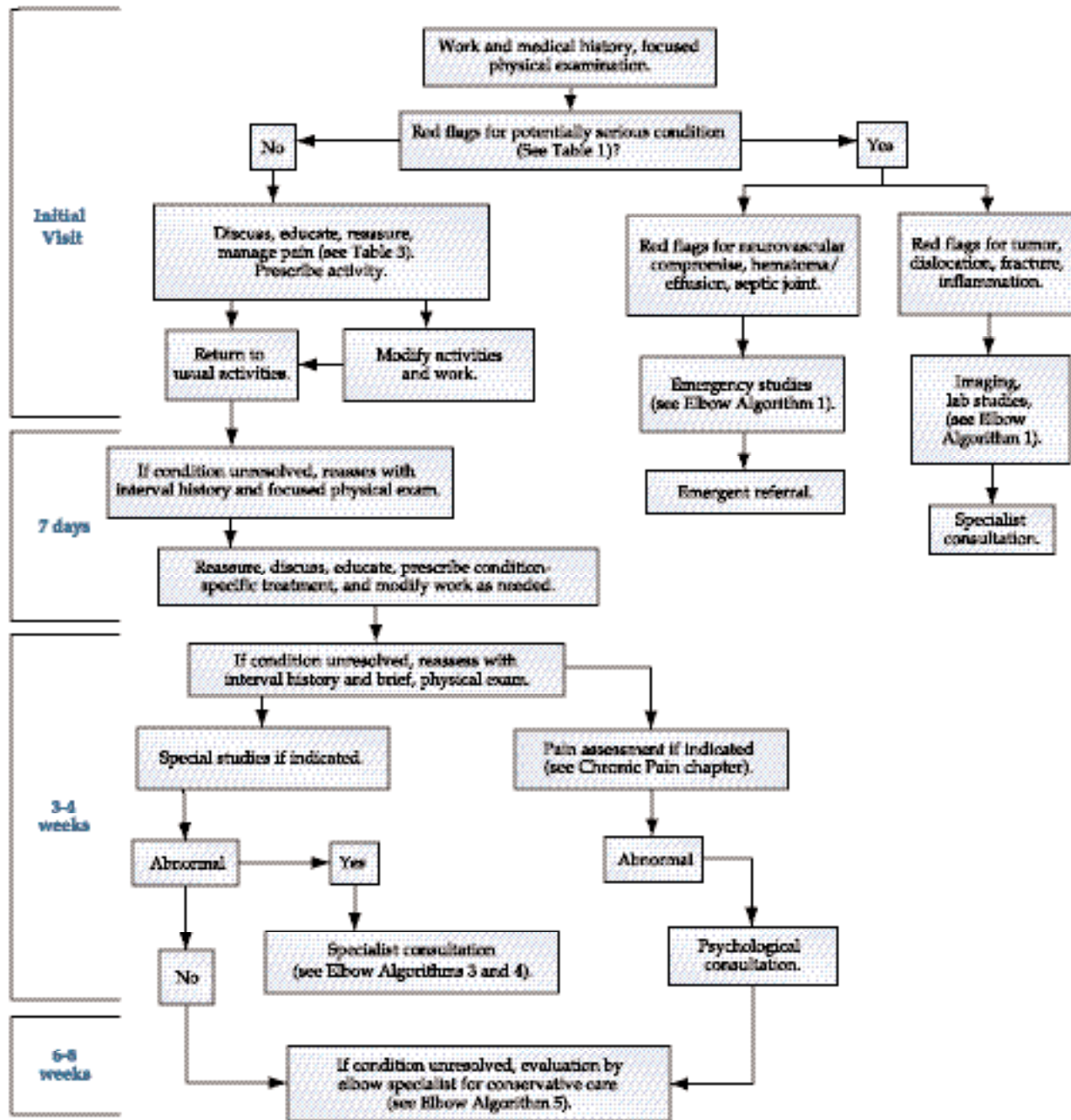
C = **Limited evidence-base:** At least one study of intermediate quality.

I = **Insufficient evidence:** Evidence is insufficient or irreconcilable.

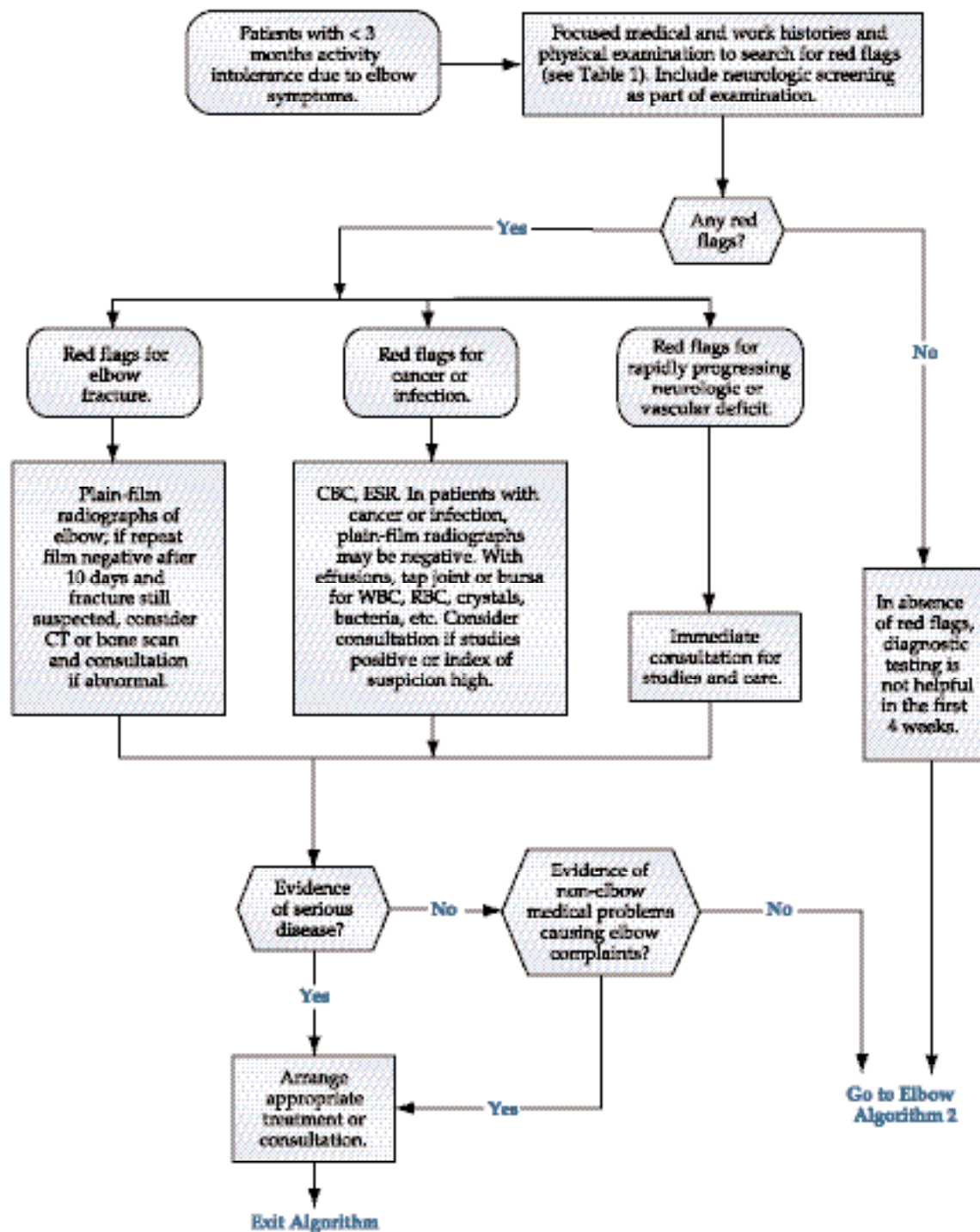
* For therapy and prevention, RCTs with narrow confidence intervals and minimal heterogeneity. For diagnosis and screening, cross sectional studies using independent gold standards. For prognosis, etiology or harms, prospective cohort studies with minimal heterogeneity.

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

Master Elbow Algorithm. ACOEM Guidelines for Care of Acute and Subacute Elbow Disorders

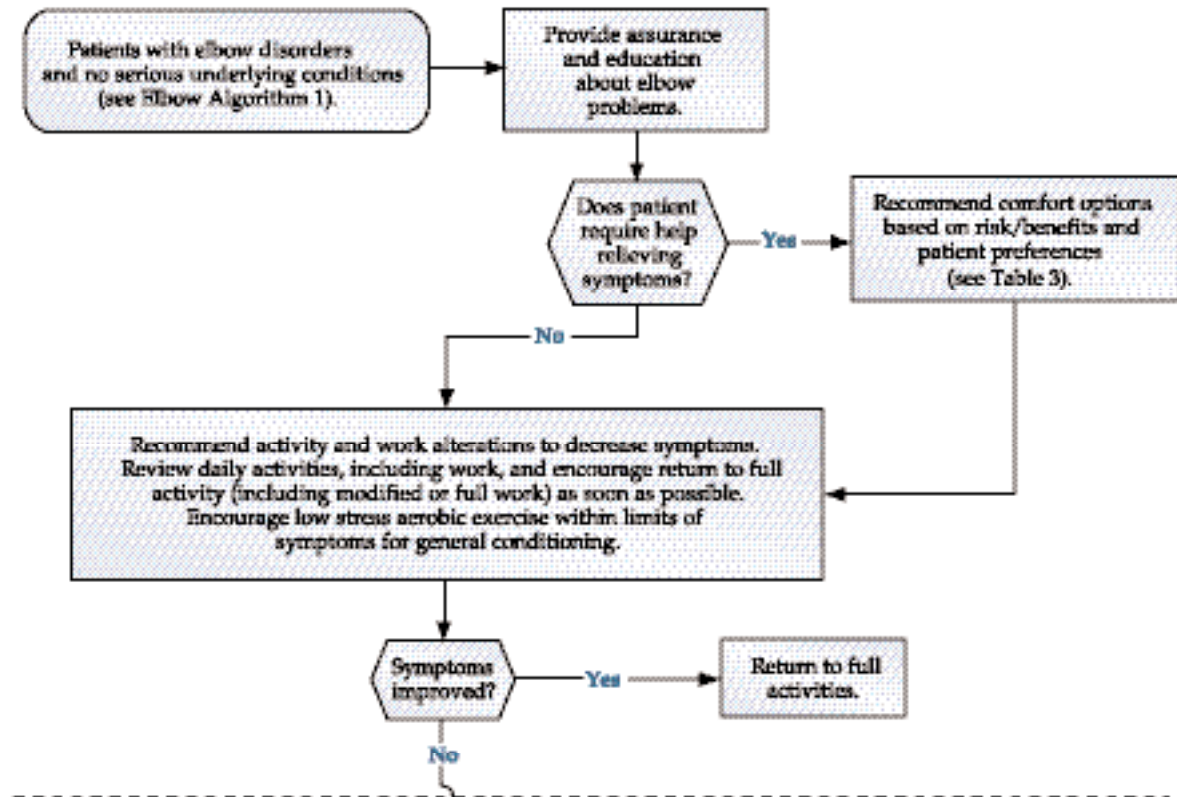


Elbow Algorithm 1. Initial Evaluation of Elbow Disorders

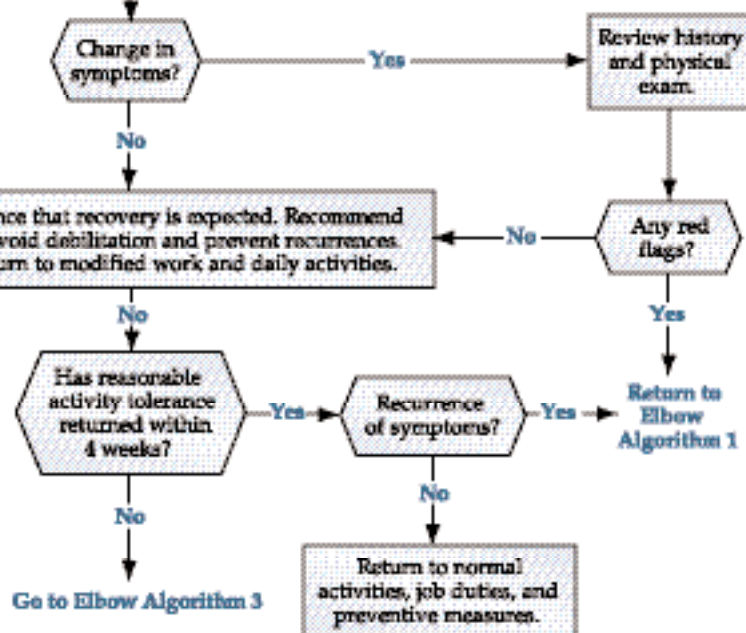


Elbow Algorithm 2. Initial and Follow-up Management of Elbow Disorders

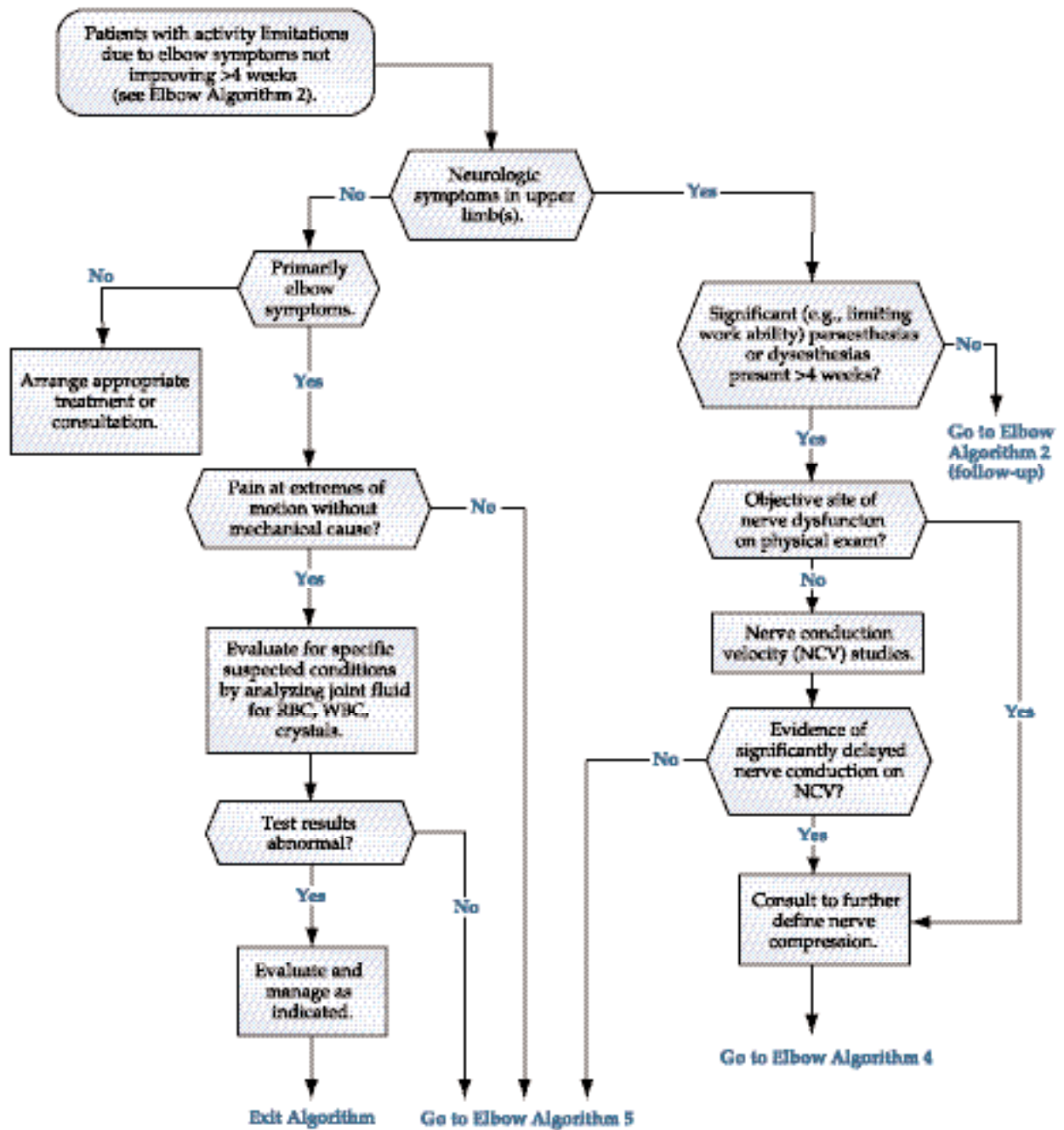
Initial Visit



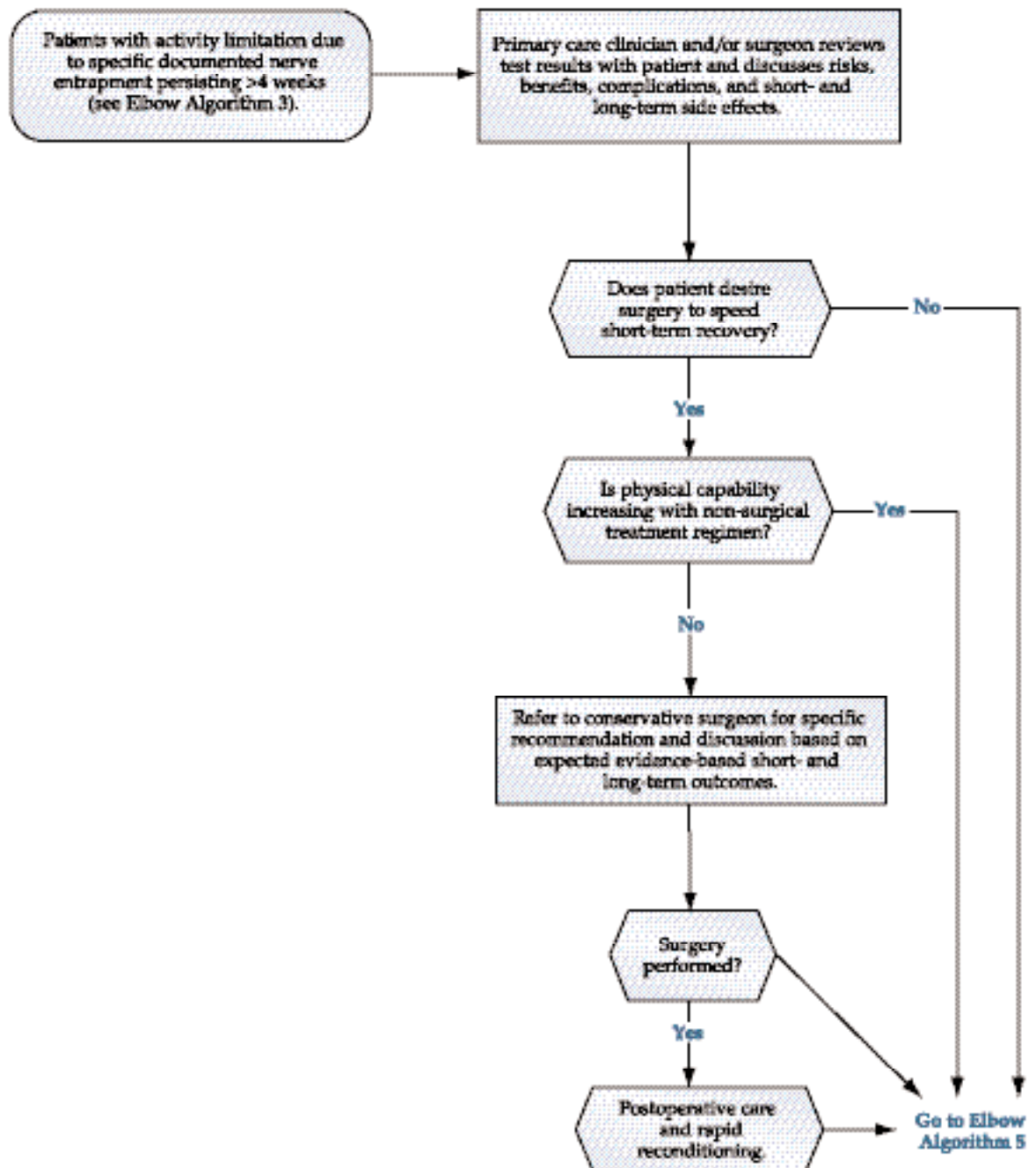
Follow-up Visit



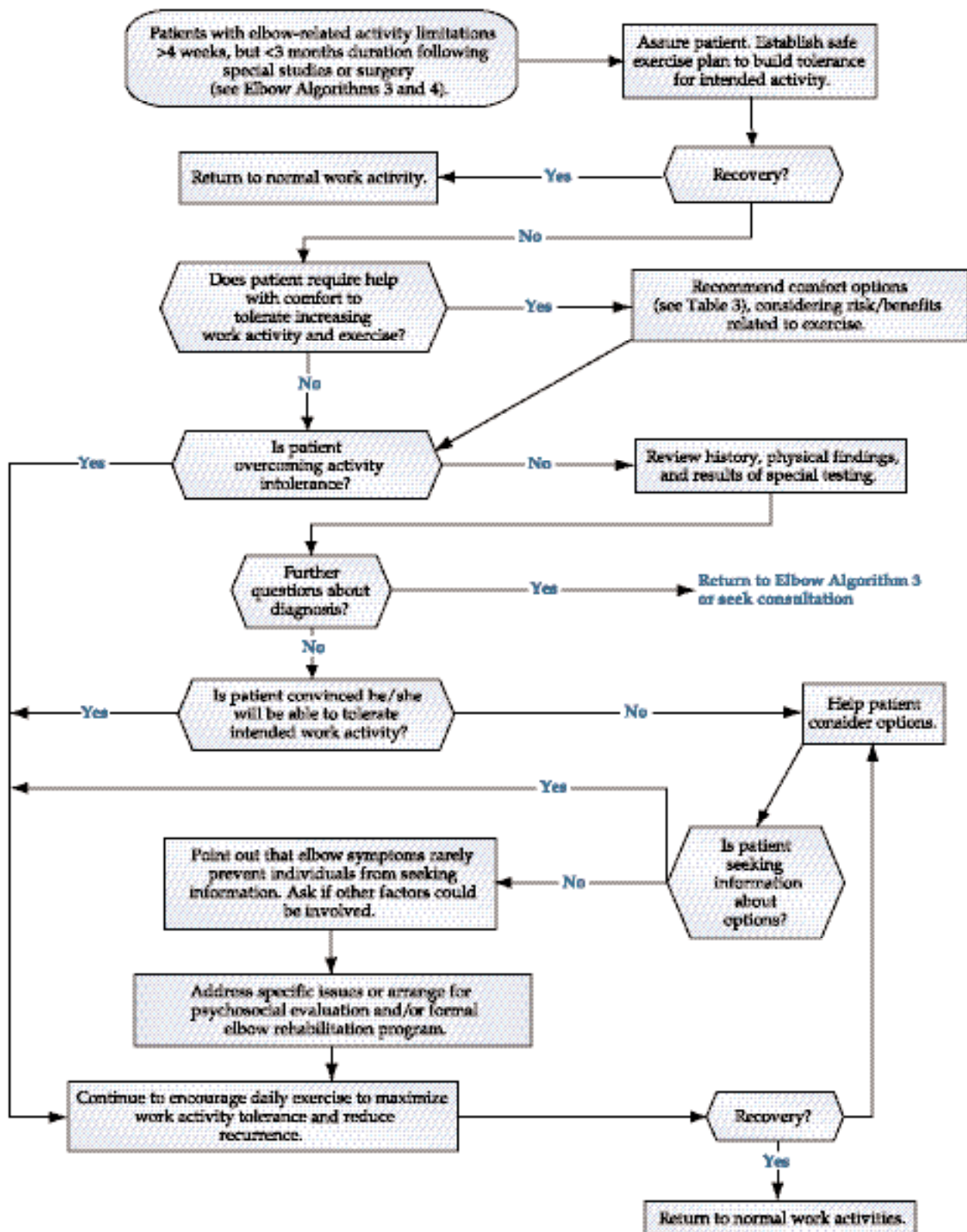
Elbow Algorithm 3. Evaluation of Slow-to-Recover Patients with Elbow Disorders (Symptoms >4 Weeks)



Elbow Algorithm 4. Surgical Considerations for Patients with Anatomic and Physiologic Evidence of Nerve Compression Coupled with Persistent Elbow Symptoms



Elbow Algorithm 5. Further Management of Elbow Disorders



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DISCLOSURE OF CONFLICTS OF INTEREST

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Research Grants/Other Support—None

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