INJURIES OF THE SHOULDER

Conditions of the neck or upper thoracic spine may cause referred pain to the shoulder. The comprehensive evaluation of shoulder pain includes careful examination of the cervical and thoracic spine.

1. Impingement Syndrome, Rotator Cuff Tendinosis or Tears, Supraspinatus Tendinitis, Subacromial Bursitis

The term **impingement syndrome** has replaced more diffuse diagnostic terms such as **bursitis** and **tendonitis** in the definition of shoulder pain following either repeated overuse or sudden overload. This pathology accounts for most shoulder pain that occurs spontaneously or with occupational loads.

In the normal shoulder, the coracoacromial ligament crosses the supraspinatus tendon of the rotator cuff. In some individuals, when a hand is brought from the side to an overhead position in forward flexion or abduction, there may be contact pressure or impingement of the acromion and coracoacromial ligament on the rotator cuff or the intervening bursa. The pathology starts with a subacromial bursitis and may progress to an irritation of the supraspinatus tendon or tendonitis. Further progression leads to the beginning of ulceration (partial-thickness tear) of the tendon, which can lead to a full-thickness discontinuity or rupture of the rotator cuff. The long head of the biceps projecting across the joint beneath the cuff to its origin on the supraglenoid tubercle may be damaged. Paralleling these soft-tissue changes, the anteroinferior aspect of the acromion develops osteophytic lipping with further encroachment on the subacromial space.

The onset of anterior shoulder pain may be gradual or acute. Occasionally, the onset coincides with the start of new repetitive-motion work activities, especially overhead work. Patients may be unaware of the inciting activity. The pain may be expressed generally over some aspect of the anterior shoulder. In some cases, pain is limited to the lateral arm about the deltoid insertion on the humerus. Occasionally, pain is referred to the distal arm, elbow, and rarely, to the hand.

All levels of pain occur, including severe pain at rest caused by a tense subacromial bursa. Night pain is a common complaint that brings the patient to medical treatment.

Posttraumatic impingement syndrome may occur after a minor injury to the arm or shoulder. The self-imposed immobilization of the shoulder predisposes the patient to the impingement syndrome because of imbalanced rotator cuff muscle function secondary to painful inhibition of normal motion.

**Clinical Findings**

On physical examination, patients begin to experience anterior shoulder pain when the arm is abducted to 30–40 degrees or flexed forward to 90 degrees or more. With the elbow flexed at 90 degrees, active external rotation usually does not cause discomfort. However, internal rotation (when the patient attempts to place his or her thumb on the opposite inferior angle of the scapula) is painful. With significant disruption of the rotator cuff, a patient may have no active elevation past 90 degrees of flexion or weakness to external rotation. However, patients can have full-thickness tears of the rotator cuff without lost motion. Point tenderness anterior to the acromion over the subacromial bursa is common. Two common tests for impingement are the **supraspinatus isolation test** (empty can test), and the **Hawkins-Kennedy test** (Figure 9–1).

**Differential Diagnosis**

Angina caused by myocardial ischemia may be confused with primary shoulder disease. Cervical radiculopathy can also present as pain radiating into the shoulder. Acute shoulder sepsis may mimic acute bursitis because of the comparable severity of pain. Sepsis usually is associated with systemic signs, such as an elevated erythrocyte sedimentation rate and white blood cell count, but is, in fact, quite rare. Osteoarthritis of the glenohumeral joint is not common and may be indistinguishable from some aspect of the impingement syndrome until plain radiographs are obtained. Pain from symptomatic
Imaging & Diagnostic Studies

Plain x-rays include an anteroposterior (AP) view of the shoulder taken in internal and external rotation and an axillary and an outlet view. These may show some sclerotic change at the greater tuberosity or evidence of acromioclavicular (AC) joint degenerative arthritis. With massive disruptions of the cuff, the humeral head may be elevated in relationship to the glenoid cavity.

An MRI can determine the state of the cuff, as well as the presence of bicipital tendon pathology, labral tears, muscle atrophy indicating nerve injury, subluxation, dislocation, and other soft-tissue changes. However, it is not necessary to make a specific diagnosis of cuff tear if the patient’s symptoms improve. With progressive age, there is an increasing incidence of asymptomatic partial- or full-thickness cuff tears such that after 70 years of age, most people will have cuff tears.

Prevention

Avoidance of prolonged or repeated overhead work may help lessen the incidence of impingement type pain. In addition, rotator cuff strengthening exercises can sometimes improve the symptoms associated with pathology in this area.

Treatment

The goals of treatment are to resolve the patient’s pain and restore normal function and muscle balance around the shoulder. This usually can be accomplished with nonoperative treatment. Patients with less severe symptoms can be started on anti-inflammatory medications, pendulum exercises, and shoulder rotator cuff exercises. Pendulum exercises are performed with the individual flexing at the waist, relaxing all shoulder girdle musculature, and dangling the involved arm in a pendulum-like fashion. This reduces the pressure on the impinged area and may increase the circulation to the tendon. Selective contraction of the internal and external rotator cuff muscles depresses the humeral head and reduces the pressure in the subacromial space. Patients are taught to do this using resistance exercises such as with an elastic band (Thera-Band), with the arm at the side, elbow flexed 90 degrees, applying force in internal and external rotation.

The fastest way to resolve impingement symptoms is to inject the subacromial space with corticosteroid and local anesthetic (eg, triamcinolone 40 mg and 1% lidocaine 4 cc). This mixture is injected with a no. 25 needle directed at the point of the shoulder toward the greater tuberosity 2.5 cm inferior to the anterolateral quarter of the acromion. The diagnosis is made when the patient’s symptoms are relieved immediately. The patient then is started on progressive resistance exercises.

Patients who respond only temporarily to the injection or who develop recurrence after two or three injections and who have participated in proper exercises may be candidates for surgery or arthroscopic surgery to decompress the subacromial space. This includes removal of bone from the undersurface of the acromion and AC joint, bursectomy, and cuff debridement and repair as necessary.

2. Bicipital Tendinosis

The biceps brachii muscle has two heads, a short head that originates from the coracoid process and a long head that originates from the supraglenoid tubercle. The long head then passes along the intertubercular groove of the humerus. The tendon can become inflamed within this groove resulting in pain and stiffness.

Clinical Findings

Patients will have anterior shoulder pain that is often worse with overhead activity. On physical examination, the patient will have point tenderness in the area of the intertubercular groove anteriorly over the humerus.

Differential Diagnosis

Bicipital tendinosis or tendinitis must be differentiated from other causes of anterior shoulder pain such as impingement or rotator cuff pathology.

Imaging & Diagnostic Studies

The diagnosis of bicipital tendinosis can be made clinically. Plain x-rays are often normal but ultrasound or MRI may show thickening of the tendon or fluid around the tendon. MRI may be useful to identify other pathology around the shoulder.

Prevention

Strengthening the muscles of the rotator cuff and the scapular stabilizers may help prevent bicipital tendinosis, as can avoidance of repetitive or sustained overhead activity.

Treatment

Initial treatment involves rest and nonsteroidal anti-inflammatory drugs (NSAIDs) followed by rehabilitation consisting of scapular stabilization techniques and rotator cuff strengthening. Ultrasound-guided steroid injection around the tendon can also be effective. Finally, surgery consisting of debridement, biceps tenodesis, or tenotomy can be considered in refractory cases.

3. Labral Tears

The glenohumeral joint is surrounded by a fibrocartilagenous rim that helps to deepen and stabilize the joint. This labrum can be torn with either an acute injury or from repetitive overhead activity such as in a throwing athlete. Tears that occur over the superior part of the labrum are known as SLAP lesions, or superior labral anterior to posterior lesions, and are often seen in throwing athletes such as pitchers. Bankart lesions involve tearing of the labrum and a portion of the inferior glenohumeral ligament from the anterior and inferior portion of the joint. This type of lesion is seen with traumatic dislocation of the shoulder.
Clinical Findings

Complaints associated with SLAP lesions can be vague. Patients may have a deficit of internal rotation compared to the other side. The O'Brien test may be used to aid in diagnosis. The patient is asked to forward flex his or her adducted arm in full pronation against resistance by the examiner. This maneuver causes pain in the presence of a SLAP tear. The pain is improved when the test is repeated with the arm in supination. Patients with Bankart lesions will often have a history of a shoulder dislocation and injury and may show signs of anterior apprehension on examination.

Differential Diagnosis

Other causes of shoulder pain including impingement, tendonitis, and rotator cuff pathology should be considered. MRI is useful in differentiating these conditions.

Imaging & Diagnostic Studies

Plain x-rays are usually not useful in making this diagnosis and even a simple MRI cannot detect all labral tears. An MRI with arthrogram is more sensitive in assessing the labrum.

Prevention

Careful adherence to proper mechanics with throwing can help prevent SLAP type lesions.

Treatment

Therapy consisting of strengthening the dynamic stabilizers of the shoulder as well as proprioceptive feedback may be helpful in chronic instability. However, large labral lesions that are symptomatic often require arthroscopic repair.

4. Shoulder Osteoarthrosis

Osteoarthritis at the shoulder joint may occur at the glenohumeral and/or acromioclavicular (AC) joints.

Clinical Findings

Patients will present with decreased range of motion of the shoulder and pain with shoulder motion. They may also have tenderness and swelling over the AC joint.

Differential Diagnosis

Osteoarthritis of the shoulder has a similar presentation to adhesive capsulitis but the two are distinguishable by x-ray.

Imaging & Diagnostic Studies

Plain x-rays, including an anteroposterior (AP) view of the shoulder taken in internal and external rotation as well as an axillary and an outlet, will show narrowing of the glenohumeral or AC joint with subchondral cysts and osteophyte formation.

Prevention

Massive rotator cuff tears may be associated with progression to arthritis, and patients with this condition should be advised that treatment of the tear may help prevent the development of arthritis.

Treatment

Conservative treatment includes rest, NSAIDs, and therapy. Steroid injection can also be performed into the glenohumeral or AC joint. Injection into the glenohumeral joint is often done under fluoroscopic guidance. Surgery for AC joint arthritis may consist of arthroscopic or open distal clavicle resection. The glenohumeral joint can be treated with arthroplasty.

5. Frozen-Shoulder (Adhesive Capsulitis)

In patients with frozen-shoulder syndrome, there is marked restriction of glenohumeral joint motion, presumably in response to diffuse capsular inflammation. The etiology is unknown but the condition may be associated with diabetes or other endocrine or autoimmune conditions.

Clinical Findings

These patients may be comfortable at rest, and symptoms are produced when they attempt to move the glenohumeral joint beyond that allowed by the inflammation and adhesions. All ranges of motion are limited. Loss of axial humeral rotation (internal and external rotation) with the elbow at the side is diagnostic. Adhesive capsulitis frequently is confused with loss of motion from rotator cuff pathology. In the latter situation, there is no loss of axial rotation.

Differential Diagnosis

Plain radiographs can be used to differentiate this condition from osteoarthritis of the glenohumeral joint.

Imaging & Diagnostic Studies

Standard radiographs are normal in this condition but may be ordered to rule out underlying arthritis.

Prevention
There is no known method of prevention.

### Treatment

Resolution of pain from a frozen shoulder requires a short period of sling immobilization for pain relief. However, after this, patients should undergo a dedicated program of rehabilitation and therapy. Shoulder motion will recover gradually with therapy over 6–18 months. Recovery of motion can be facilitated initially by distension of the glenohumeral joint with 30 cc fluid, saline with lidocaine, and triamcinolone diacetate 0.5 cc. This is followed by gentle manipulation of the arm into external rotation.

#### 6. Shoulder Dislocations

The anatomy of the shoulder contributes to the ease with which shoulder dislocations can occur. Stability of the large humeral head in the shallow 5 cm × 2.5 cm glenoid depends on the shoulder capsule and specific ligament attachments to the margins of the glenoid. Excessive force applied in any direction may cause a dislocation. With forces applied to the arm held in a position of abduction and external rotation, the humeral head is driven forward, tearing the anterior and middle glenohumeral ligaments and capsule from the margin of the glenoid. The humeral head is driven out anteriorly and rests in a position anterior and inferior to the glenoid. Rarely, the humeral head can dislocate posteriorly with automobile accidents, grand mal seizures, or electroshock therapy. In young people with lax ligaments and psychiatric disabilities, it may be dislocated intentionally.

#### Clinical Findings

Acute anterior shoulder dislocation results from a specific injury and is associated with severe anterior shoulder pain. The patients may be aware of a configurational change in the shoulder. Patients guard against shoulder motion by holding the elbow flexed with the ipsilateral forearm in the opposite hand. Any attempt at motion is associated with severe pain. Posterior dislocations are less obvious.

#### Differential Diagnosis

Other injuries to the shoulder area such as fractures or acute rotator cuff or labral tears should be considered.

#### Imaging & Diagnostic Studies

AP and axillary radiographs are obtained in all suspected dislocations. Anterior dislocations will show the humeral head displaced inferiorly to the glenoid, confirming the diagnosis. In posterior dislocations, the humeral head is at the same level as the glenoid on the AP radiograph. The diagnosis can be confirmed with an axillary view, which shows the head posterior to the glenoid. Posterior dislocations may be missed in initial screening radiographs in the absence of an axillary view.

#### Prevention

General fall prevention and good seizure control may help prevent dislocations. Strengthening of the dynamic stabilizers of the shoulder may be helpful in chronic dislocators.

#### Treatment

Anterior and posterior dislocations are reduced by closed techniques immediately. Anterior dislocations can be reduced by various methods, including the Hippocratic maneuver. This technique involves gradual axial distraction to the arm in a position of forward flexion. Countertraction is applied to the axilla with the patient under intravenous analgesia (such as 40–100 mg meperidine HCl [Demerol]). Gentle rotation of the arm into internal rotation frequently assists reduction. Confirmatory radiographs are obtained after reduction.

Following reduction, patients are immobilized with the elbow at the side and the arm in a position of 10 degrees of external rotation for 3 weeks. This position as compared with a sling and the arm in internal rotation is a new concept based on better anatomic contact between the torn labrum and the glenoid. Patients are allowed to return to their usual activities at 6–8 weeks. Long-term rates of success with this position of immobilization are unknown. If patients become recurrent dislocators, repair of the torn capsular attachment from the labrum of the glenoid anteriorly can be done either arthroscopically or with open surgery. Acute posterior dislocations usually require temporary immobilization in a position of slight abduction, shoulder extension, and external rotation to keep the humeral head reduced.

#### 7. Multidirectional Instability

Individuals with ligamentous laxity may have shoulder joints that sublux easily in the anterior, posterior, or inferior direction. In the absence of injury, patients are asymptomatic. Following a minor injury in which the shoulder joint is subluxed forcibly, patients may continue to have shoulder pain with daily activities and symptoms of instability with different positions of the shoulder and arm.

#### Clinical Findings

Physical examination may demonstrate evidence of ligamentous laxity in the wrists, elbows, and knees. Shoulder examination will reveal laxity and excessive translation of the humeral head in the anterior and posterior directions. Patients may demonstrate the instability voluntarily.

#### Differential Diagnosis

SLAP lesions and other labral tears can have a similar presentation.

#### Imaging & Diagnostic Studies

MRI imaging may be helpful to rule out labral pathology.
There is no known method of prevention, but shoulder strengthening as stated below may improve the symptoms.

Treatment

Treatment is directed at educating the patient to adjust to the problem, altering his or her lifestyle, strengthening the shoulder, and delaying symptomatic activities. In some patients, surgical repair is directed at correcting the dominant directional instabilities.

8. Clavicular Fractures

Clavicle fractures usually occur from a direct blow to the shoulder and rarely from falling on an outstretched hand. Middle-third fractures are most common. Distal-third fractures are infrequent.

Clinical Findings

The proximal fragment of the clavicle is elevated by the action of the sternocleidomastoid; the weight of the shoulder displaces the distal fragment downward. Local swelling occurs from bleeding from the fracture site. The patient supports the involved extremity with the opposite hand. Rarely, a proximal fragment can perforate the skin, producing an open fracture.

Differential Diagnosis

Dislocations at the AC joint can have a similar presentation.

Imaging & Diagnostic Studies

Plain radiographs of the clavicle are sufficient for diagnosis.

Prevention

Prevention includes avoidance of falls and workplace safety.

Treatment

Immobilization of the fracture is provided by the application of a figure-of-eight bandage or a sling and swath. It is doubtful that a figure-of-eight sling or even a plaster bolero will influence the fracture position. Some mild cosmetic deformity usually is present. Surgery consisting of open reduction with internal fixation may be indicated for distal third fracture, highly displaced fractures, fractures with tenting of the skin, or for early return to work or sporting activity. Open fractures are considered surgical emergencies.

9. Proximal Humeral Fractures

Isolated fractures of the proximal humerus can occur after a direct fall onto the arm or elbow.

Clinical Findings

Clinical symptoms include pain experienced over the proximal shoulder region or radiating the length of the arm. Local swelling is noted on examination from bleeding at the fracture site. Dissection of the hematoma may be noted onto the anterior chest after a few days.

Differential Diagnosis

Dislocation of the glenohumeral joint can have a similar presentation.

Imaging & Diagnostic Studies

Evaluation is with plain radiographs of the scapula and shoulder. These include AP radiographs of the scapula and proximal humerus and a lateral scapular view. An axillary view is necessary to rule out a dislocation of the head fragment.

Prevention

Fall prevention and the treatment of osteoporosis may help decrease the incidence of these fractures.

Treatment

The four-part classification of proximal humeral fractures of Neer is helpful in deciding treatment. Nondisplaced or minimally displaced fractures of the surgical or anatomic neck or of the greater or lesser tuberosities can be treated by temporary immobilization. Displaced fractures of one or both tuberosities are indicative of a rotator cuff tear. Displaced fractures may require surgical treatment by open reduction and internal fixation. Four-part fractures can result in lost blood supply to the humeral head and may require prosthetic replacement. Dislocation of the fractured humeral head requires reduction, usually by operative methods.

Instruction in early shoulder motion is required both for unfixed and for operated fractures. The goal of physical therapy is to restore normal range of motion and strength around the shoulder. Patients should be progressed from active range-of-motion to resistive exercises beginning with isometrics and progressing to isotonic exercises.

10. Acromioclavicular Joint Separation

Acromioclavicular joint injuries may result from falls or from direct trauma to the arm or shoulder. They are common in contact sports such as ice hockey and football. Stability across the acromioclavicular joint is provided primarily by the conoid and trapezoid ligaments. These ligaments, which are connected to the undersurface of the clavicle, suspend the scapula in the upright position by their attachment at the base of the coracoid process. The less robust acromioclavicular ligaments and the attachments of the deltoid musculature between the clavicle and the arm provide additional stability.
minor injuries, the ligaments of the acromioclavicular joint are stretched, and with increased force, the coracoacromial ligaments are injured as well. In severe injuries, the deltoid can be partially avulsed from its origin at the clavicle or acromion.

Clinical Findings

Signs and symptoms include pain and tenderness over the acromioclavicular joint and deformity.

Differential Diagnosis

Clavicle fractures have a similar clinical appearance and can be differentiated by plain radiographs.

Imaging & Diagnostic Studies

Radiographs of the injured shoulder will rule out a fracture of the clavicle or proximal humerus. Displacement of the acromioclavicular joint usually can be demonstrated on an AP view of the joint. Shoulder radiographs can be taken with the patient holding a weight or with traction.

Prevention

Fall avoidance and workplace safety can prevent these injuries.

Treatment

Treatment for most injuries consists of relieving symptoms by using a sling to immobilize the shoulder and support the weight of the arm. Patients may resume activity as comfort returns. Once the shoulder is stable in terms of decreased pain (4–6 weeks), physical therapy may be helpful for increasing strength. The usual residual of AC injuries is a mild cosmetic deformity caused by prominence of the distal end of the clavicle. If there is severe disruption of the AC joint with detachment of the deltoid or tenting of the skin, surgery may be indicated.

11. Brachial Plexus Neuropathy—Thoracic Outlet Syndrome

Thoracic outlet syndrome is a set of symptoms and signs caused by compression of the neurovascular structures passing out of the chest and neck and beneath the clavicle to the axilla. Compression of the vessels and nerves of the brachial plexus and/or subclavian vessels occurs in the interscalene triangle, behind or below the clavicle or subcoracoid space, or more distally at the pectoralis minor. Cervical ribs or congenital fibrous bands and rarely a nonunion or malunion of the clavicle can lead to thoracic outlet compression. The disorder is uncommon and the diagnosis is missed frequently. Women are affected more frequently than men, usually between the ages of 20 and 50.

Clinical Findings

The neurogenic disorder is more common than the vascular. Patients report pain and/or paresthesia radiating from the neck or shoulder and down to the forearm and fingers. They usually have difficulty with overhead activities. The hand may feel swollen or heavy. The lower trunk of the brachial plexus is involved more commonly, producing signs of numbness, tingling, and weakness in the ulnar-innervated intrinsic muscles and symptoms on ulnar side of the forearm and hand. Patients also may have venous compression or arterial insufficiency from the outlet.

Differential Diagnosis

The diagnosis can be confused with cervical disk disease at the C7–T1 level (which is rare), which may produce a C8 radiculopathy. Entrapment of the ulnar nerve in the cubital tunnel or Guyon canal usually can be distinguished by the physical examination or appropriate electromyography (EMG). Provocative maneuvers (Figure 9–2) such as overhead exercise or standing in the military brace position will obliterate the ipsilateral radial pulse and produce symptoms. More important, one should look for the reproduction of symptoms with specific controlled neural tension maneuvers, for example, controlling the stretch on the brachial plexus through scapular depression, shoulder abduction (to 90 degrees) and external rotation, wrist/finger extension, followed by either elbow extension with forearm supination or elbow flexion with pronation. Other maneuvers, held for 60 seconds, may also reproduce symptoms, for example, Adson maneuver, Wright test, Roos Test or shoulder hyperabduction to 180 degrees. With these maneuvers, also observe the palm for pallor indicating an accompanying vascular compromise.

Imaging & Diagnostic Studies

Plain radiographs of the cervical spine should be studied for congenital differences such as cervical ribs and long transverse processes or even hypoplastic first ribs. Apical lordotic chest views are indicated to rule out Pancoast-type tumors. Sophisticated MRI and angiographic or high-resolution CT scans may be helpful. Electromyography may be useful, especially if muscle weakness is present.

Prevention

This condition may be secondary to an anatomic abnormality, but the symptoms can be triggered by overhead work or working on a computer with a forward head posture. Identification and correction of postural triggers are an important part of management.

Treatment

The initial treatment is conservative and depends on appropriate postural strength training to reduce the mechanism of thoracic outlet compression. The
1. Lateral Epicondylitis (Tennis Elbow)

Lateral humeral epicondylitis is also called “tennis elbow” because it is a common problem among tennis players. It can occur among workers who perform repeated high-force pinching or power grasps, work with the wrist in sustained extension, or repeatedly move the wrist forcefully in extension. The pathologic process involves tendon tears and necrosis at the attachment of the extensor carpi radialis brevis (ECRB) to the lateral humeral epicondyke and the extensor carpi radialis longus origin along the supracondylar line. The injury may be more proximal at the ECRB tendon muscle junction. The term epicondylitis is a misnomer because the pathology is related more to fibrosis and degenerative changes to the tendon than an acute inflammatory process.

Clinical Findings

Patients may have ill-defined elbow symptoms or pain radiating into the dorsal aspect of the forearm. Symptoms may occur at night and at rest, but usually they are mechanical and related to activity, especially grasping (e.g., steering wheel), wrist dorsiflexion or supination (e.g., turning a door knob).

On examination, there is local tenderness over the lateral epicondyle or distal along the common extensor origin. Sometimes there is pain at the distal third of the humerus at the origin of the extensor carpi radialis brevis. Because pain occurs with grasping, patients may complain of weakness. Symptoms can be reproduced by asking the patient to straighten the elbow then extend the wrist against resistance (Cozen test) (Figure 9–3); or extend the middle finger against resistance with the wrist straight; or grasp the back of a chair with the elbows straight and attempt to lift it (Chair test).

Differential Diagnosis

The symptoms of radial head osteoarthritis, which is rare, can resemble those of tennis elbow. A plain-film radiograph will usually distinguish the two disorders.

A fractured radial head or neck, caused by falling on an outstretched hand, may cause similar symptoms. The history of trauma and anterior and lateral plain-film radiographic views will establish the diagnosis of a fracture.

Radial tunnel syndrome, caused by entrapment of the posterior branch of the radial nerve, may be considered in refractory cases although symptoms are usually more distal. Pain may be aggravated with resisted supination with the elbow slightly flexed.

Referred pain from C6 radiculopathy or a shoulder tendinopathy may be ruled out by an examination of the upper arm, shoulder, and neck.

Imaging & Diagnostic Studies

Diagnosis is based on the clinical examination. With major trauma or refractory symptoms, imaging studies can be considered to rule out fracture or arthritis. MRI may be useful to rule out intra-articular pathology.

Prevention

General strengthening of elbow and forearm musculature and proper instruction in the use of hand tools and/or modification of the hand tool may prevent lateral humeral epicondylitis in workers at risk. The intervention should be to reduce high-force pinching or gripping or repeated forceful wrist or finger flexion.

Treatment

Treatment of lateral epicondylitis is a matter of debate considering the slow natural history of healing after the aggravating activity is eliminated. Removing or modifying the offending activities is fundamental for chronic disorders or temporarily for acute episodes. Patients should be instructed to avoid forceful pinching or gripping especially with wrist extension. Forearm muscle strengthening is helpful after the acute pain has resolved. Strengthening should be initiated with low loads with slow progression. For example, start with wrist curls using 250 g weights (or equivalent rubber tubing) and increasing the load each week or two. Although there is no evidence of long-term effectiveness of counterforce braces, there may be a
Nonsteroidal anti-inflammatory drugs and ice can be considered for painful episodes especially with night pain, but there is no evidence that they are valuable when taken continuously.

Steroid injections can reduce the pain for short durations (eg, weeks), but there is little evidence of long-term value. The steroid can be injected in multiple small doses into the most tender areas of the epicondyle or common extensor origin. Occasionally, a second injection is necessary. Complications include fat necrosis, local skin atrophy, and loss of pigmentation (usually temporary) in darker-skinned patients.

Injections with platelet-rich plasma (PRP) demonstrated no benefit in randomized controlled trials.

Physical therapy including stretching of the extensor origin and isometric and concentric exercises are often suggested. There is little evidence of value of eccentric muscle training or extracorporeal shock therapy.

Surgical consisting of debridement of the common extensor origin or extensor carpi radialis brevis, with or without repair, is rarely necessary, but remains a possibility for recalcitrant and confirmed lateral epicondylitis.

2. Medial Epicondylitis (Golfer’s Elbow)

Medial epicondylitis can occur in golfers and baseball pitchers as well as in manual workers who do repeated forceful finger or wrist flexion or wrist pronation, especially when the elbow is flexed. Patients have pain on the medial aspect of the elbow radiating to the forearm. Many similarities exist between lateral and medial epicondylitis, including risk and prognosis factors, diagnosis strategy, prevention, and treatment.

Clinical Findings

Physical examination findings include local tenderness over the medial epicondyle or common proximal flexor origin. The symptoms can be reproduced by resisted wrist flexion.

Differential Diagnosis

As with lateral epicondylitis, osteoarthritis, other intra-articular pathologies, and referred pain of cervical radiculopathy are on the differential list.

Ulnar nerve entrapment at the elbow is an important differential diagnosis and is sometimes associated with medial epicondylitis. The tissue swelling associated with medial epicondylitis can compress the ulnar nerve.

Referred pain from C8–T1 radiculopathy or a shoulder tendinopathy may be ruled out by an examination of the upper arm, shoulder, and neck.

Imaging & Diagnostic Studies

Diagnosis is based on the clinical examination. With major trauma or refractory symptoms, imaging studies can be considered to rule out fracture or arthritis. MRI (increased T2 signal) may be useful to rule out intra-articular pathology. A nerve conduction study can rule out ulnar neuropathy.

Prevention

General strengthening of elbow and forearm musculature and proper instruction in the use of hand tools and/or modification of the hand tool may prevent medial epicondylitis in workers at risk. The intervention should be to reduce high force pinching or gripping or repeated forceful wrist or finger flexion.

Treatment

Treatment involves rest of the involved tissues and modified activity. Steroid injection is generally not recommended due to the risk of ulnar nerve damage. Extracorporeal shock therapy has provided conflicting results. The need for surgical relief is rare.

3. Radial Nerve Entrapment at the Elbow (Radial Tunnel Syndrome)

Radial nerve entrapment at the elbow, also called radial tunnel syndrome, can be considered in cases of resistant lateral epicondylitis. The posterior (motor) branch of the radial nerve is compressed at the arcade of Fröhse, in the inferior portion of supinator muscle, or when crossing the extensors carpi muscles. Risk factors are similar to lateral epicondylitis, but it is not considered a common disorder.

Clinical Findings

Patients typically present with pain that is 4–8 cm distal to the lateral epicondyle. The pain is aggravated by resisted supination and/or extension of the middle finger. However, none of these tests is specific for radial nerve entrapment. In severe disorders, radial deviation and weakness may be detected with extension of the first digit at the metacarpal joint.

Differential Diagnosis

Lateral epicondylitis and referred C6 radiculopathy should be considered.

Imaging & Diagnostic Studies

Nerve conduction with electromyography (without standard values) and/or MRI may be used to confirm the neuropathy but there is variability between specialists.

Prevention

Decreased biomechanical exposure to repeated forceful pinch or grip, especially with wrist extension, can be recommended, but the disorder is uncommon.
Treatment

Treatment consists on pain relief by ice or anti-inflammatory medications, relative rest with wrist splinting, and physical therapy. Activity modification includes avoiding frequent provocative maneuvers that may increase the symptoms, such as prolonged elbow extension with forearm pronation and wrist flexion.

Steroid injection with anesthetic can be considered if performed by an experienced hand or plastic surgeon. If conservative treatment fails to improve patients' symptoms after 6 months, surgical treatment may be considered.

4. Ulnar Neuropathy at the Elbow (Cubital Tunnel Syndrome)

Ulnar nerve entrapment at the elbow, also called *cubital tunnel syndrome*, is considered the second most common nerve entrapment disorder after carpal tunnel syndrome. The ulnar nerve may be trapped, irritated, or subluxed in its anatomic course through the ulnar tunnel (also called cubital tunnel), at its entrance into the forearm through the cubital tunnel retinaculum (arcuatum or Osborne ligament) and at the arch of origin of the flexor carpi ulnaris. Compression of the nerve in the tunnel may be related to old elbow injuries with enlarging osteophytes, cubitus valgus deformity at the elbow, or subluxation of the nerve out of the groove. Work-related medial epicondylitis, contact stress (eg, truck driving), or sustained elbow flexion (eg, telephone use) may cause localized edema, nerve compression, ischemia, fibrosis, and neuropathy.

Clinical Findings

Patients present with neuropathic symptoms (eg, numbness, tingling, aching, burning, shooting, or stabbing pain) in the ulnar innervated fingers (eg, small and ring fingers) and less frequently in the medial aspect of the forearm and elbow. They may also experience allodynia (eg, normal touch is perceived as painful) or weakness. Symptoms are frequently aggravated by elbow flexion or resting the elbow on a work surface.

On physical examination, there may be a Tinel sign or tenderness over the ulnar nerve in the cubital tunnel or the tenderness may be localized proximally near the distal triceps or distally at the cubital tunnel retinaculum. Full elbow flexion for 60 seconds (with wrists straight) may trigger the symptoms (Figure 9–4). Sensory examination in the ulnar distribution on the fingers may be abnormal (eg, 2-point discrimination, Semmes-Weinstein monofilament testing, pin prick). Weakness and atrophy of the interossei/thumb adductor muscles indicates a more severe condition.

Figure 9–4. Elbow flexion test for 60 seconds. With ulnar neuropathy at elbow tingling or numbness may occur in fourth and fifth digits. It can be useful to follow progress of treatment by recording the time to onset of symptoms.

Differential Diagnosis

The differential diagnosis includes compression of the ulnar nerve in Guyon canal at the wrist (uncommon), cervicothoracic C8–T1 radiculopathy, or brachial plexus neuropathy (eg, thoracic outlet syndrome). The physical examination or nerve conduction studies should be able to identify the location of the entrapment.

Medial epicondylitis may be the inciting factor and should always be considered with possible ulnar neuropathy at the elbow.

Imaging & Diagnostic Studies

Diagnosis of cubital tunnel syndrome is made from a combination of clinical data and nerve conduction studies of the ulnar nerve across the elbow. Recently, ultrasound and MRI have shown some value in identifying morphological changes of the nerve within the cubital tunnel.

Prevention

Occupational risk biomechanical factors for medial epicondylitis should be minimized. Work practices should be modified to eliminate sustained elbow flexion, for example, use of telephone head set instead of handheld telephone. In addition, sustained contact stress, such as resting the arm on arm-rest that presses on the unlar groove, should be avoided.

Treatment

Treatment is conservative initially. In addition to pain relief, the most commonly described methods of conservative treatment are activity modification, such as avoiding elbow flexion of 90 degrees or more or pressure over the medical epicondyle region. Night-time elbow splints should be used that are comfortable, maintain the elbow in approximately 45 degrees of flexion, and do not put pressure on the nerve.

Patients with interosseous muscle atrophy or who do not respond to conservative management may require surgical decompression of the nerve in the canal, medial epicondylectomy, or anterior transposition of the nerve subcutaneously or submuscularly.

5. Olecranon Bursitis

Olecranon bursitis is an irritation and swelling in the normally occurring bursa between the olecranon prominence and the overlying skin. Acute forms are usually not work-related but due to inflammation or sepsis, although a sudden trauma at work might precipitate an inflammation. The chronic type is much more common in men and is usually caused by repeated contact stress on the elbow.

Clinical Findings

Patients usually present with a history of gradual swelling and pain, although these symptoms may occur acutely after a direct blow to the olecranon process. Signs of increased warmth suggest a septic process or another cause of inflammation. Localized fluctuant swelling will be present with or without sepsis/inflammation. Pressure exacerbates the pain.

Differential Diagnosis
Sepsis and inflammatory diseases, like rheumatoid disease, crystalline deposits, or CREST (calcinosis, Raynaud phenomenon, esophageal dysmotility, sclerodactyly, and telangiectasia) syndrome are the main differential diagnoses.

### Imaging & Diagnostic Studies

Aspiration of the bursa and specific blood tests are useful depending on the differential suspected. Aspiration is best performed by introducing the needle at least 2.5 cm away from the bursa and then tunneling beneath the skin before actual penetration. This technique may prevent secondary infection of a sterile bursa. MRI in complex cases may be indicated (hypointensity on T1-weighted images).

### Prevention

Prevention is based on protection of repetitive trauma on the posterior face of the elbow. Use of a protective pad in specific jobs highly exposed to elbow trauma is usually effective.

### Treatment

In addition to the use of a protective pad to prevent reinjury, simple immobilization is adequate in most cases. For acute and painful cases, an elastic bandage and steroid injection (after infection is ruled out with an aspiration of the bursal fluid) may be used. For recurrent bursitis, arthroscopic bursal resection may be required.

### 6. Anterior Interossei & Pronator Syndrome

The median nerve can be compressed in the proximal forearm just distal to the antecubital fossa between the two muscular heads of the pronator teres. The anterior interosseus branch of the median nerve may be also compressed. This branch innervates the radial half of the flexor digitorum profundus, the flexor pollicis longus, and the pronator quadratus. These entrapments are rare and only case studies have been reported. The biomechanical risk factors may be forceful pronation, thumb adduction, or wrist flexion.

#### Clinical Findings

In both cases, patients present with hand weakness, but those with pronator syndrome may present with paresthesia similar to carpal tunnel syndrome but with pain in the proximal volar forearm. These symptoms may be aggravated by repetitive pronation movements and are not reproduced by provocative median nerve testing at the wrist. Pronation against a resistance (hold patient’s distal forearm) may reproduce symptoms.

With anterior interosseus syndrome, patients have difficulty pinching between the thumb and index finger. The thumb and index finger form a flat and triangular shape instead of normal round “OK” sign.

#### Differential Diagnosis

Carpal tunnel syndrome, brachial plexus neuropathy, and C6 radiculopathy are the primary differential diagnoses.

### Imaging & Diagnostic Studies

Nerve conduction studies with electromyography can establish both diagnoses and rule out other neuropathies. In cases of significant motor loss, MRI may be useful to assess a particular anatomical variation that should to be treated.

#### Treatment

The tension in the involved muscles must be reduced to decrease the impingement. Conservative management includes avoidance of aggravating activities, such as forceful pronation, thumb adduction, and wrist flexion curls. If conservative treatment is unsuccessful or if motor loss is significant, surgical decompression may be needed.

### 7. Elbow Osteoarthritis

Elbow osteoarthritis (OA) is a relatively rare condition that occurs almost exclusively in males, and has a strong association with repetitive strenuous use of the arm in activities ranging from weight lifting to operating vibrating heavy machinery. Elbow OA is marked by osteophytes formation whereas OA secondary to a trauma with intra-articular fracture includes osteophyte formation and joint space narrowing, bone sclerosis, and subchondral cysts. Sometimes, the OA associated with cumulative use is called primary OA of elbow to differentiate it from OA secondary to a prior trauma.

#### Clinical Findings

Progressive diffuse pain is not specific. During the early course of the disease, when the joint space is still maintained, osteophytes in the olecranon fossa and the proximal portion of the olecranon cause pain in maximal extension. Similarly, if osteophyte formation occurs in the trochlea or in the coronoid process, impingement pain may be noted in extreme flexion. Patients may complain of pain throughout the arc of motion, but this is typically a late finding when the disease is more advanced.

#### Differential Diagnosis

The differential includes secondary OA or rheumatoid arthritis.

### Imaging & Diagnostic Studies

Imaging is necessary to confirm the diagnosis. Plain radiograph or computed tomography of the elbow are usually adequate and show evidence of OA with osteophytes.

### Treatment
Conservative treatment is considered if fracture is not displaced but surgery is necessary in most cases. Conservative therapy includes PRICE (protection, rest, ice, compression and elevation) before and during medical evaluation. Acute dislocations should be reduced in the emergency room under adequate sedation and splinted until evaluation by a surgeon. Rehabilitation should be performed as soon as possible with early range of motion exercise.

**INJURIES OF THE WRIST & HAND**

Injuries or pain in the hand and wrist are common in the workplace, particularly in occupations that involve a forceful and repetitive pinching or finger loading. Careful assessment of symptoms and a focused physical examination are necessary to make the proper diagnosis since the symptoms can often be vague and difficult to reproduce.

1. **Nonspecific Forearm, Wrist, or Hand Pain**

Workers sometimes present to the occupational medicine clinic with nonlocalizing aches or pains in the distal upper extremities or symptoms that change in quality and location with time. Approximately half of these have a normal physical examination. These patients may have an early preclinical condition that has yet to declare itself with no localizing symptoms or physical findings. These patients can be rewarding or frustrating to manage depending on the approach to treatment.

One approach is to treat these as somatizations and try to identify and address underlying psychological or psychosocial factors that may be triggering symptoms. This approach should be considered if the symptom location and quality change with time and there is no apparent aggravation by specific tasks or biomechanical activities. Psychosocial factors at work can be explored by enquiring about relationships with coworkers and supervisors; concerns of job loss; the patient’s pattern of wellbeing and energy level through the workweek; etc. Talking through constructive approaches to difficult work or home life may be very useful. A poor sleep pattern may also suggest psychosocial factors. The poor sleep pattern and symptoms respond well to daily exercises as simple as nondirected walks. Or they may respond to low-dose pm tricyclic antidepressants or other mood altering medications. These patients may benefit from a referral to a therapist.

Another approach is to try to identify the specific tasks and biomechanical activities at work or home that aggravate the symptoms. This approach is most useful if the symptom location does not change over time and the patient can identify specific aggravating activities. The physician should consider the ergonomic risk factors that might affect tissues in the location of the symptoms. For example, pain in the elbow region may be due to the repeated forceful pinching or gripping; sustained wrist extension; or contact stress at the elbow. For pain at the wrist, consider sustained wrist extension or ulnar deviation; sustained forearm pronation; repeated wrist motion; or contact stress on the volar surface of the wrist. Interventions should be proposed that directly address the aggravating activities. For example, some computer users are symptomatic using a conventional keyboard or mouse because their symptoms are aggravated by forearm pronation. They may respond well to a split keyboard and an asymmetrical mouse. The patient should be warned that their symptoms may take several weeks to resolve after the intervention is implemented. A number of workplace intervention studies have demonstrated a benefit of symptom reduction following the introduction of new tools or changes in work practices that address ergonomic risk factors.

In general, physicians should avoid using the terms repetitive strain injury or cumulative trauma disorder as a diagnosis but should instead identify the specific disorder or disorders, when possible. If there are no localizing physical examination findings, it is appropriate to use “hand pain” or “elbow pain.” Effective treatments and prognoses are different between the specific disorders and the use of generic terms can cloud effective management.

2. **Ganglion Cyst**

Ganglion cysts are the most common soft tissue tumor of the hand. These mucin-filled cystic lesions occur most often in the second to fourth decades. They can be asymptomatic or produce pain with direct pressure or during certain wrist motions. Patients seek care when they change size or become symptomatic.
Clinical Findings

Ganglion cysts can be associated with a joint capsule or tendon sheath. They are most commonly found over the dorsum of the wrist but can also occur on the volar side. They are well circumscribed and feel fluid filled. If they are large enough, then they can be transilluminated with a small penlight. When they occur in the hand, they are typically found on the volar surface and may present as a small, round, “BB-like” firm mass near the base of the digits.

Differential Diagnosis

Other types of soft tissue masses should be considered, particularly if the mass feels more solid than cystic.

Imaging & Diagnostic Studies

The diagnosis can be made clinically. Radiographs can be useful if the mass feels bony or calcified in nature. The diagnosis can also be confirmed with an MRI, CT scan, or ultrasound if the physical examination is inconclusive.

Prevention

A few workplace studies link ganglion cysts to work involving repeated wrist motions, but the evidence is limited.

Treatment

Asymptomatic lesions can be observed and will occasionally resolve on their own, particularly if they are small and have been present for less than a year. Avoiding weight-bearing with wrist extension can help decrease pain associated with dorsal wrist ganglia. Aspiration can be performed in the clinic although recurrence rates after aspiration has been reported to be 50–70%. Use of a large bore needle (eg, 18 gauge) to puncture the cyst walls may decrease recurrence. Injection with steroid has been shown to have an increased incidence of skin depigmentation and subcutaneous fat atrophy. Surgical excision can be performed for symptomatic ganglia that do not respond to conservative treatment.

3. De Quervain Tenosynovitis (First Dorsal Wrist Extensor Compartment Tenosynovitis)

De Quervain tenosynovitis involves the first dorsal compartment of the wrist. The involved tendons include the abductor pollicis longus and the extensor pollicis brevis. The onset is usually associated with overuse of the thumb and wrist particularly with radial deviation, as in repetitive hammering, lifting, or pipetting. The tenosynovial lining will show low-grade inflammation.

Clinical Findings

Patients in new, hand intensive job activities or those who engage in repetitive lifting may complain of pain in an ill-defined area along the radial side of the base of the thumb, occasionally extending as far distally as the interphalangeal joint. This condition is also seen in new or nursing mothers. There is usually very localized tenderness over the radial side of the distal radius and swelling may be present. When the patient grasps the fully flexed thumb into the palm and then ulnar deviates the hand at the wrist, exquisite pain develops and reproduces the patient’s complaint (Finkelstein test) (Figure 9–5).

Figure 9–5. Finkelstein test. With the thumb clasped in the palm as shown, the wrist is deviated toward the ulna, producing pain over the first dorsal extensor compartment.

Differential Diagnosis

Chronic nonunion of the scaphoid bone occasionally produces similar symptoms. Pain associated with osteoarthritis of the first carpometacarpal joint, which occurs in approximately 25% of white women older than 55 years of age, may mimic De Quervain tenosynovitis, which occurs in younger patients.

Imaging & Diagnostic studies

This is primarily a clinical diagnosis and there are no specific radiographic findings. However, radiographs of the wrist can rule out carpometacarpal osteoarthritis and nonunion of the scaphoid bone.

Prevention

Patients are instructed to lift with the palm facing upwards (full supination) rather than with the palm down, and avoid using the thumb. Tools can be modified to reduce repeated forceful thumb flexion especially with the wrist in a non-neutral posture. The thumb that strikes the spacebar on a keyboard, usually the right, may be at risk.

Treatment

The first line of treatment can be activity modification including lifting with the palm in supination, avoiding repetitive lifting and thumb abduction, and use of a thumb spica splint to immobilize the thumb. NSAIDs can be helpful for pain management.

Steroid injection is often successful at curing this condition. Injection is generally performed with a combination of local anesthetic and steroid given into the tendon sheath over the area of the radial styloid with a single injection using a 25-gauge needle. Every attempt should be made to place the injection within the sheath and avoid subcutaneous injection of steroid that can cause skin depigmentation and fat atrophy. Only 1–2 cc of total fluid will fit into the tendon sheath.

In patients who do not respond to local injection, surgical decompression of the common extensor sheath by incision may be necessary. Patients who have certain anatomic variations, such as a separate subsheath for the extensor pollicis brevis tendon or multiple slips of the abductor pollicis longus, may be less likely to respond to injection. Unfortunately, there is no reliable way of distinguishing these patients clinically or radiologically.
4. Other Extensor Tendinopathies of the Wrist

Tendonitis can occur at five other specific sites on the extensor side of the wrist (Figure 9–6). The common sites are intersection syndrome (ECR, third compartment), extensor digitorum communis (EDC, fourth compartment), and extensor carpi ulnaris (ECU, sixth compartment). Intersection syndrome (ECR travels beneath muscles of APL and EPB) and fourth extensor compartment tenosynovitis (EDC) can occur with repeated or sustained wrist extension or other overuse, such as with excessive typing or mousing. ECU tendonitis occurs after a twisting injury and presents as vague or deep pain over the ulnar side of the wrist. EDC synovitis with swelling and fluid is unusual outside the setting of inflammatory or crystalline arthropathy, and patients with these findings should be evaluated for these conditions.

Clinical Findings

It is useful to localize the tendonitis to the specific compartment. There may be very localized tenderness or pain with resisted loading of the tendon/muscle. Patients with tendonitis over the ECU tendon have ulnar-sided wrist pain that can often extend from the insertion point over the base of the fifth metacarpal bone, over the distal ulna, and into the distal forearm. The pain is often worse with resisted wrist extension and ulnar deviation. Similarly, tendonitis of the ECR tendons creates pain at the second and third metacarpal that also can extend into the forearm. Pain with this condition tends to be worse with resisted wrist extension and radial deviation. Intersection syndrome occurs at the distal forearm where the muscle bellies of the tendons the first dorsal compartment cross over the radial wrist extensors, causing compression in this area.

Differential Diagnosis

ECU tendonitis must be distinguished from a tear of the triangular fibrocartilage complex. ECR tendonitis can be confused with De Quervain or scaphoid fractures or nonunions as well as radiocarpal arthritis.

Imaging & Diagnostic studies

Tendonitis is primarily a clinical diagnosis. However, MRI studies will sometimes show fluid or inflammatory changes around the affected tendon.

Prevention

Reduction of duration of forceful gripping and repeated wrist motion may prevent these conditions for hand intensive work. For computer users, ergonomic modifications can reduce wrist extension with keyboard and mouse use.

Treatment

The primary treatments include activity modifications, wrist splints, NSAIDs, and, if indicated, ergonomic evaluation of work tasks and tools. Corticosteriod injections can be done but should be limited in number to prevent the risk of tendon rupture. Surgery is only indicated in very rare instances of refractory pain.

5. Trigger Digit (Stenosing Tenosynovitis)

Stenosing tenosynovitis of the flexor tendon to a finger or of the flexor pollicis longus to the thumb may produce pain when the digit or thumb is forcibly flexed or extended. Motion of the proximal interphalangeal (PIP) joint of the finger or the interphalangeal (IP) joint of the thumb produces the symptoms, which is a painful snap. This causes the joint to collapse suddenly much like a trigger.

The cause of the tenosynovitis may be repetitive finger flexion. It is also associated with systemic diseases such as diabetes, thyroid dysfunction, and rheumatoid arthritis. The patient's work history may reveal a cause of the disorder; however, most cases are idiopathic.

Clinical Findings

Triggering is usually reproducible on examination but can often only be noticed if the finger is actively rather than passively flexed. In the early stages, patients may present with pain over the A1 pulley only and no triggering. Sometimes a nodule can be palpated at the A1 pulley (near the MCP joint) with passive flexion of the PIP joint. In the later stages, the digit may become "locked" in extension (or more rarely in flexion) such that the motion is so limited the triggering cannot be reproduced.

Differential Diagnosis

Traumatic injuries to the hand can cause pain in similar areas.

Imaging & Diagnostic Studies

Imaging studies are not needed to make this diagnosis and are usually normal.

Prevention

Avoidance of repetitive digit flexion against a load and good diabetic control can help prevent triggering.

Treatment

At the early stages, splinting in extension at night can help. However, injection of a combination of steroid and local anesthetic (1–2 cc total volume) into the area of the synovial sheath around the A1 pulley is often curative. Patients not responding to injection or developing recurrent symptoms may require
6. Carpal Tunnel Syndrome

Carpal tunnel syndrome is an entrapment or pressure neuropathy of the median nerve as it passes through the carpal tunnel volar to the nine flexor tendons. The canal boundaries are the rigid transverse carpal ligament on the volar side and the carpal bones on the dorsal side.

Carpal tunnel syndrome affects workers of any age but is more common in women. Pregnancy, increasing age, and obesity increase the risk. Symptoms may appear after an injury, such as a direct blow to the dorsiflexed wrist or an injury associated with a Colles fracture. Rheumatoid arthritis, which causes inflammation in the sheath surrounding the flexor tendons, is an example of a space-occupying lesion that produces the encroachment. Rare hypothyroid patients with myxomatous tissue in this area are at risk for bilateral symptoms. While the cause of the syndrome is unknown in many cases, repeated or sustained forceful gripping or repetitive wrist and finger movements involved in work have been associated with carpal tunnel syndrome. There continues to be controversy about the association between carpal tunnel and the use of a keyboard or computer mouse. Patients with carpal tunnel syndrome may find that keyboarding, especially with the wrist in extension or forearms in full pronation, exacerabates their symptoms.

Clinical Findings

In the absence of an acute injury, patients can develop paresthesias in the median nerve distribution gradually and spontaneously (volar surface of the thumb, index, and long fingers as well as the radial half of the ring finger). With progression of the syndrome, patients may be awakened at night with pain, tingling, burning, or numbness in this area of the hand. Characteristically, patients tend to stand up and massage the area or shake the wrist and fingers. Symptoms may also occur with driving or sustained gripping. Further progression may lead to hand weakness. Untreated carpal tunnel syndrome with progressively worsening symptoms may result in permanent damage to the median nerve with consequent persistent skin sensory deficit and thenar motor atrophy and weakness.

When patients are seen early, there is no evidence of thenar atrophy, and sensation (2-point discrimination at 4 mm) remains intact. Patients who hold their wrists maximally flexed for 60 seconds (Phalen sign) may develop symptoms or direct pressure with the thumb over the carpal tunnel area can also recreate symptoms (carpal compression test) (Figure 9–7A). Tapping with a reflex hammer at the volar wrist may recreate shooting pains into the tips of the digits (Tinel sign). There may be diminished abductor pollicis brevis strength (Figure 9–7B). The diagnosis is confirmed by median nerve electrodiagnostic studies (nerve conduction studies and EMG).

Differential Diagnosis

Pain in the median nerve distribution with entrapment at the carpal tunnel should be distinguished from median nerve compression occurring proximally. Occasionally, cervical radiculopathy (C5, C6, C7) or pronator teres syndrome may resemble this condition, but neurologic examination should distinguish between these.

Imaging & Diagnostic Studies

Imaging studies are not needed to make this diagnosis. Nerve electrodiagnostic studies are helpful in both confirming the diagnosis and estimating the severity of nerve dysfunction. The nerve conduction study should be temperature adjusted.

Prevention

Avoidance of repeated or sustained forceful gripping or repetitive wrist and finger movements, prolonged wrist flexion or extension, or direct pressure on the carpal tunnel can help prevent symptoms. There are many examples of tools or jigs that allow work to be performed with less forceful pinch or grip. Some examples are the use of anti-torque bars on inline screwdrivers; tool clutch adjustment to minimally effective torque; tools with lower force switches; and tool balancers that support the weight of the tool. Tools that reduce sustained posture extremes such as split keyboards or those that reduce extreme pronation such as asymmetrical computer mice may also be useful.

Treatment

Underlying conditions, such as rheumatoid arthritis or hypothyroidism, causing carpal tunnel should be treated. In the absence of signs of neuropathy, patients are instructed in reducing provocative or repetitive activities. Wrist splints holding the wrist in neutral are effective in alleviating symptoms. Splinting consistently at night for a period of 4–6 weeks can be curative in the early stages. Carpal tunnel syndrome associated with pregnancy usually responds to splinting and the symptoms resolve after delivery. For patients not responding to rest and splinting, injections of cortisone into the carpal tunnel (with care to avoid injection into the median nerve) can be beneficial. Patients who fail to respond to the preceding measures or whose symptoms recur may require carpal tunnel release surgery, endoscopically or open. When patients present with signs of nerve injury, constant numbness, loss of sensibility, or thenar atrophy, early surgery is preferred. Surgery is well documented to be beneficial when performed on patients with confirmed carpal tunnel, therefore the diagnosis should be confirmed by electrodiagnostic studies before surgery is undertaken.

7. Ulnar Neuropathy at Wrist, Hypothenar Hammer Syndrome

Ulnar neuropathy at the wrist can be caused by a space-occupying lesion in the area of Guyon canal. Patients have loss of sensation over the ulnar hand and weakness of the hypothenar, interosseous muscles, and even “clawing” of the hand. Hypothenar hammer syndrome is a vascular injury of the ulnar artery that occurs with compression or repetitive “hammering” using the hypothenar eminence. The superficial palmar branch of the ulnar artery lies in close proximity to the hamate and repetitive trauma can cause occlusion of the branch resulting in diminished arterial flow to the second through fifth digits.
Clinical Findings

Callousing over the hypothenar eminence may be present. With ulnar neuropathy at the wrist, the patient may have diminished sensation of the small finger and ulnar border of the ring finger. At later stages, atrophy of the hypothenar muscles and the interosseous muscles can develop as well as clawing of the hand. Patients with hypothenar hammer syndrome present with signs of ischemia such as cold sensitivity, decreased capillary refill, discoloration, or tip necrosis. The Allen test may be useful to evaluate ulnar artery blood flow.

Differential Diagnosis

Systemic causes of neuropathy, cubital tunnel syndrome, T1 radiculopathy, and Raynaud syndrome should all be considered on the differential diagnosis.

Imaging & Diagnostic Studies

MRI or CT scan is often helpful to identify an occult lesion in Guyon canal or elsewhere over the ulnar nerve. Neurodiagnostic studies can also be used to determine the area of compression and degree of dysfunction. Arteriography is very useful in confirming the diagnosis of hypothenar hammer syndrome.

Prevention

Repetitive hammering with the hypothenar eminence of the hand should be avoided. Sheet metal workers should use a rubber mallet.

Treatment

Ulnar neuropathy at the wrist due to an occult mass needs to be surgically treated to relieve the symptoms. Release of Guyon tunnel can also be done in the absence of a mass. The treatment of hypothenar hammer syndrome is more controversial. Avoidance of smoking, keeping the digits warm, and calcium channel blockers may be helpful. Often there is enough redundancy in the hand vasculature that conservative treatment can be used until the collateral circulation becomes more robust. However, surgical interventions such as embolization or resection of the thrombosed segment with or without vein grafting are sometimes needed.

8. Hand Arm Vibration Syndrome

Hand arm vibration syndrome (HAVS) involves both neurologic and vascular signs and symptoms associated with the use of electric and pneumatic vibrating hand tools. Tools, such as chain saws, chipping hammers, riveting guns, blowers, grass trimmers, grinders, sanders, and rock drills may have high levels of handle vibration and their use over months or years may lead to HAVS. Because most vibration from small power tools is absorbed by the fingers and palm, clinical pathology is usually confined to the distal upper extremity. Modern chain saws and many vibrating commercial tools have reduced handle vibration compared to earlier models. However, limited tool maintenance or the use of worn or imbalanced cutting heads will generate higher exposure risk. The clinical expression of HAVS occurs most commonly with outside work performed in colder climates. However, the underlying pathology is caused by the tool signature not cold temperature.

Clinical Findings

The classic presentation, which is the basis for tool standards, is cold-provoked blanching of the fingers, thus the term vibration white fingers (VWF) or occupational Raynaud phenomenon. At lower exposures, neurologic symptoms predominate. These symptoms usually begin as problems of hand coordination and fine manipulation. Progression includes intermittent numbness, tingling, and pain (see Stockholm Workshop Scales for severity assessment). Hand and arm pain and hand paresthesias are relatively common in hand tool users, and may be related to nerve compression or chronic soft tissue injury. Accordingly, differentiation of exposures and precise diagnosis of the medical condition are essential. At earlier stages, vascular signs and symptoms can be stabilized and reversed if vibration exposure is minimized or stopped. Because neurologic symptoms may involve either mechanoreceptors or trunk nerves, the prognosis is more variable. The most severe cases that involve skin trophic changes and gangrene are rarely seen. Their presence requires more extensive investigation for a major comorbidity, such as a collagen vascular disease or obstructive arterial disease. The examination should include skin perfusion evaluation, digit sensory testing where available, such as with monofilaments or 2-point discrimination, and provocative maneuvers for distal nerve compression, as in the carpal tunnel syndrome (CTS).

Differential Diagnosis

Raynaud disease and entrapment neuropathies, such as CTS and thoracic outlet syndrome should be considered. CTS and digital nerve pathologies are more complex because vibratory exposure is likely to be complicated by intrinsic risks and biodynamic workplace factors. In addition, because VWF is a vasospastic disorder, routine noninvasive vascular imaging will usually be normal. Thoracic outlet syndrome (TOS) can be a confounding diagnosis because of its independent effects on large arteries and the brachial plexus. However, vascular expressions of TOS are unusual and can be visualized by Doppler, angiography, MRA, or multidetector CT.

Imaging & Diagnostic Studies

Sensory function can be evaluated with the vibration and thermal perception threshold tests (VPT and TPT), but these types of quantitative sensory tests (QSTs) have limited availability. Nerve conduction studies may be useful for evaluating digital nerve function and to rule out or rule in a component of CTS. The value of using finger systolic blood pressure or laser Doppler to evaluate vasospasm, under conditions of cold provocation, has a long established acceptance, but application is highly specialized. Routine noninvasive vascular tests are not useful, unless an obstructive pathology is under consideration.

Prevention

Use of power tools with lower levels of handle displacement (mm) or acceleration (m/s²) can reduce the incidence and even prevent HAVS. The handle vibration level of vibrating hand tools should be available from the manufacture and compared to national (ANSI; EU) and international (ISO) standards. Exposure can also be reduced by reducing the minutes of tool use per day to below thresholds set by national and international standards. Monitoring of...
exposure duration and symptoms is especially important for tools with high levels of handle vibration. Vibration exposure levels can also be reduced with jigs or tool balancers that support the tool and isolate the vibration from the worker or reduce the grip force required to use the tool. The use of antivibration gloves or tape wrapped around tool handles can effectively reduce vibration exposure levels at higher frequencies. However, their utility under different working conditions, patterns of tool use, and grip force characteristics remains undetermined. Smoking cessation is highly beneficial because it reduces arterial vasospasm.

Treatment
Treatement involves minimizing exposure to vibrating hand tools. If carpal tunnel syndrome is also present, carpal tunnel surgery may be useful.

9. Wrist Sprain
Wrist sprains are common and usually involve a fall onto an outstretched hand with stretching of the dorsal wrist capsule or high-force loads such as occurs when a high-torque drill binds and twists the hand and forearm. The patient presents with pain and swelling over the dorsal wrist.

Clinical Findings
Patients will have dorsal wrist pain over the radiocarpal joint and may have swelling and ecchymosis in this area as well.

Differential Diagnosis
Fractures of the radius or carpus must be ruled out. Any patient with tenderness in the anatomic snuffbox should be assumed to have an occult scaphoid fracture and treated accordingly. Patients may also have a tear of the scapholunate (SL) ligament.

Imaging & Diagnostic Studies
Imaging studies including a PA, lateral, and oblique of the wrist can be used to rule out fracture. Patients with snuffbox tenderness should be further evaluated with a scaphoid view. Clenched-fist views of the wrist can be helpful to evaluate for widening of the scapholunate joint, which suggests injury to the SL ligament. An MRI can be obtained to look for a ligament injury or occult fracture.

Prevention
Safe work practices to prevent falls and use of wrist guards during high-risk sporting activities can help prevent these common injuries. High-torque hand tools such as drills should have the clutch or torque limiter engaged. High-torque drills should be used with two hands instead of one.

Treatment
Rest, wrist splinting, and NSAIDs are the mainstay of treatment for wrist sprains.

10. Ulnar Collateral Ligament Injury of the Thumb (Skier’s or Gamekeeper’s Thumb)
Forcible radial deviation of the thumb can cause partial or complete disruption of the ulnar collateral ligament with or without fracture. This condition can be seen in skiers when the thumb is injured forcibly against the ski pole. Scottish gamekeepers were thought to develop chronic attenuation of the same ligament by breaking the necks of ducks and other game by gripping the neck with both hands and rotating the forearms. Splinting can be used for stable injuries or nondisplaced avulsion fractures. Open surgical repair should not be delayed when there is a question of instability.

Clinical Findings
Rupture of the ulnar collateral ligament will cause pain and tenderness over the ulnar border of the thumb metacarpophalangeal (MP or MCP) joint (the three joints of the thumb are CMC [carpometacarpal], MCP, and IP). The ligament sometimes retracts proximal to the insertion of the adductor pollicis insertion and a lump (known as a Stener lesion) can be felt in this area. The thumb MCP joint should be evaluated for stability by gentle radial deviation in full extension and 30 degrees of flexion. Increased laxity or a “soft” endpoint in both positions when compared to the normal side suggests a complete tear.

Differential Diagnosis
Fractures in the area as well as simple sprains of the MCP joint and radial collateral ligament injuries are on the differential.

Imaging & Diagnostic Studies
Radiographs of the thumb can be used to diagnose avulsion injuries. MRI can be helpful for differentiating full from partial tears if the examination is equivocal.

Prevention
Avoidance of repetitive forced radial deviation can prevent chronic attenuation of the ligament.

Treatment
Partial tears or nondisplaced avulsion injuries can be treated with thumb spica casting for 6 weeks. Compliant patients can be treated with a hand-based thumb spica splint to include the MCP joint, but they must be cautioned to wear this full-time except for skin care and avoid any thumb radial deviation when the splint is off. Full-thickness tears with instability or those with a Stener lesion are treated with surgical repair or reconstruction.

11. TFCC Tears
The triangular fibrocartilage complex (TFCC) consists of ulnocarpal ligaments, the subsheath of the extensor carpi ulnaris tendon, the radioulnar ligaments, and a central fibrocartilagenous disk similar to the meniscus in the knee. The TFCC provides stability at the distal radioulnar joint (DRUJ). It can be torn from a fall onto an outstretched hand or other causes of high-force wrist loading.
Clinical Findings

Patients with an acute tear will have pain over the ulnar portion of the wrist. It can be vague and is often described as “deep” in this area. They will be tender just distal to the ulnar head. Passive ulnar deviation of the wrist may worsen their pain. The DRUJ may be unstable and should be tested by stabilization of the radius with one hand and moving the distal ulna dorsally and volarly with the other and checking for laxity. The joint should be checked with the forearm in full pronation, neutral, and full supination and compared to the other side. Rotation of the wrist may produce a painful catch or clunk.

Differential Diagnosis

A TFCC tear can be difficult to differentiate from ECU tendonitis. Patients with ECU tendonitis will be tender at the ECU insertion at the base of the fifth metacarpal and may have radiating pain up the forearm, whereas the pain is more localized with a TFCC tear. Mechanical symptoms such as a painful catch or clunk in certain positions are more suggestive of a TFCC tear.

Imaging & Diagnostic Studies

Radiographs of the wrist may show an ulnar styloid avulsion; however, most of these injuries are not thought to be associated with TFCC tears. 3T MRI images or MR/arthrogram can be useful in the diagnosis of TFCC tears.

Prevention

Fall prevention is important in preventing TFCC tears, as is the use of wrist splints in high-risk sporting activities. Patients with an “ulnar positive” wrist where the ulna is longer than the radius may be more prone to a central chronic TFCC tears.

Treatment

Chronic central tears can often be treated conservatively with rest, ice, and splinting. Acute tears without DRUJ instability can also be treated conservatively but may require casting for 4–8 weeks until the symptoms improve. Tears associated with mechanical symptoms or DRUJ instability are often treated with arthroscopic surgery, as are other types of tears that fail conservative treatment.

12. Kienböck Disease

Kienböck disease is avascular necrosis (AVN) of the lunate. The condition is often idiopathic but can be associated with other conditions causing AVN such as chronic steroid use. It may be bilateral. A similar condition can occur in the scaphoid and is called Preiser disease. AVN of both carpal bones has been associated with very high levels of exposure to vibrating or percussing hand tools but the evidence is not strong.

Clinical Findings

Patients will have wrist pain centered over the lunate but it may be vague in nature. They may also have swelling and synovitis of the wrist. Stiffness with wrist flexion and extension may be present.

Differential Diagnosis

Wrist sprains, scaphoid nonunions, and osteoarthritis of the wrist all have similar presentation. Kienböck tends to present in young men.

Imaging & Diagnostic Studies

PA, lateral, and oblique views of the wrist are needed to make the diagnosis and stage the disease. Typical findings include sclerosis of the lunate, lunate collapse or loss of lunate height, lunate fragmentation, and eventually degenerative changes in the radiocarpal and midcarpal joints. Stage 1 Kienböck is diagnosed on MRI only where T1 images will show decreased vascularity of the lunate. The disease occasionally occurs bilaterally and radiographs of the opposite side should also be performed.

Prevention

This condition is generally considered idiopathic but there may be an association with high levels of exposure to vibrating or percussing hand tools.

Treatment

Treatment depends on stage of the disease. Patients at the earlier stages of the disease and those with open physes can be treated with casting or splinting and can show revascularization of the lunate over 1–2 years. Patients with significant lunate collapse are often treated surgically. Those who are radial positive (radius longer than the ulna) can be treated with radial shortening or other “joint leveling procedures.” Revascularization procedures can also be done. Once degenerative changes have begun in the wrist, salvage procedures including proximal row carpectomy or partial or total wrist arthrodesis may be needed.

13. Dupuytren Contracture

Dupuytren contracture is thickening of the palmar fascia, which is the layer of tissue between the skin and the underlying tendon sheath. It typically begins as a small nodule or nodules that can grow over time to form cords. These cords eventually lead to contracture of the digit at the proximal interphalangeal and metacarpophalangeal joints. This condition is more common over the ulnar digits. It is often seen in individuals of Northern European descent, is more common in males, and has a hereditary predisposition.

Clinical Findings

At the early stages, subcutaneous, nonmobile nodules can be felt at the palm. At later stages, palpable subcutaneous cords can be felt and may extend into the digits and cause puckering of the overlying skin. Patients may have relatively fixed contractures of the MP and PIP joints and an inability to lay the hand flat on a table.
Differential Diagnosis

Other causes of contracture, such as joint sprains, missed fractures, and tendon injuries, should be considered. Other masses of the hand such as ganglion cysts or nerve sheath tumors can have a similar appearance to Dupuytren nodules.

Imaging & Diagnostic Studies

No imaging is needed to make the diagnosis. Radiographs of the involved digits may be helpful in assessing underlying arthritis. MRI imaging can be useful in differentiating Dupuytren nodules from other types of masses.

Prevention

The disease is thought to be primarily genetic in nature although there are some studies that suggest as association with alcohol abuse, smoking, and very high levels of physical exposure (vibration and force) during the working life.

Treatment

Patients who are asymptomatic can be observed. However, when the contractures reach around 30 degrees, patients may have some functional deficits. Splinting and therapy have not been shown to be particularly effective. Collagenase injections have recently been introduced into the market for this condition and thus far have acceptable midterm results. Surgical options include needle fasciotomy or open partial fasciectomy, with the open procedure remaining the gold standard.

14. Osteoarthritis of the Fingers or Wrist

Osteoarthritis of the first carpometacarpal (CMC) joint occurs in about 25% of women older than 55 years of age. Osteoarthritis of the DIP and PIP joints is also extremely common with advancing age, affecting nearly 100% of women older than the age of 80. Osteoarthritis of the fingers and wrist has been linked to stereotypical loading of the hand with tasks performed in the same way over 10–20 years.

Clinical Findings

Although the condition is frequently asymptomatic, some patients are aware of pain at the base of the thumb when grasping, such as when unscrewing large glass jars, and there may be a clinical deformity of "squaring" or a "shoulder sign" with subluxation of the base of the thumb at the CMC joint. In addition, there may be crepitus with pressure over the CMC joint. Patients may also have a positive grind test with reproduction of pain with axially loading of the thumb metacarpal onto the trapezium. The fingers may show bone spurs or synovitis at the DIP or PIP joints and patients often have limited flexion or extension at these joints.

Differential Diagnosis

The differential diagnosis of thumb CMC arthritis includes De Quervain tenosynovitis (discussed earlier) in which the tenderness and swelling are more proximal.

Imaging & Diagnostic Studies

Plain-film radiographs will demonstrate osteoarthritic changes in the joint.

Prevention

Smoking has been shown to increase cartilage degeneration. For jobs that involve repeating the same hand activities many times an hour, job rotation to other tasks involving other types of hand motions may reduce the risk.

Treatment

Most patients will respond to instructions to avoid repetitive painful activities such as extreme positions of thumb abduction. Wearing an orthosis to immobilize the thumb can minimize symptoms. For the digits, avoidance of repetitive gripping can help. Anti-inflammatory drugs are helpful for patients who experience pain at night. Steroid injection can be done into the thumb CMC joint. The DIP and PIP joints are often so small that they can be difficult to inject with a steroid. Patients refractory to conservative treatment may benefit from surgery. At the thumb CMC joint, surgery usually consists of resection arthroplasty (removal of the trapezium) with or without ligament reconstruction and/or tendon interposition. Arthritis at the DIP and PIP joints is usually treated with arthrodesis, although arthroplasty at the PIP joint can be performed for limited indications.

15. Scaphoid Fractures

Scaphoid fractures typically occur from a fall on the outstretched hand. In elderly patients with osteoporosis, the same mechanism of injury may produce a Colles (distal radius) fracture. Any patient with an acute fall and snuffbox tenderness should be treated as if they have a scaphoid fracture since early diagnosis and immobilization play a key role in healing of these fractures. Scaphoid fractures that go on to nonunion almost invariably result in degenerative changes at the wrist.

Clinical Findings

Patients will have tenderness over the anatomic snuffbox or volarly over the distal pole of the scaphoid. They may also have swelling, ecchymosis, and limited range of motion.

Differential Diagnosis
Fractures of the radial styloid, De Quervain’s tenosynovitis, and CMC arthritis can cause pain in the same area.

### Imaging & Diagnostic Studies

PA, lateral, oblique views of the wrist as well as a scaphoid view should be obtained if a scaphoid fracture is suspected. Often the fracture is only visible on one of these three views. Nondisplaced scaphoid fractures are often not apparent on initial plain radiographs and may require repeat radiographs 1–2 weeks later or advanced imaging such as an MRI or CT scan.

### Treatment

Any patient in whom a fracture is clinically suspected should be immediately immobilized with a thumb spica splint or cast until radiographs can be repeated in 1–2 weeks or advanced imaging obtained. A scaphoid fracture that is nondisplaced can be treated in a short arm thumb spica cast. Immobilization is continued until fracture union is seen radiographically, usually at least 12 weeks. The restrictions imposed by cast immobilization can be partially avoided by percutaneous screw fixation of the scaphoid. For displaced fractures, open reduction and internal fixation usually are indicated. Symptoms from a scaphoid nonunion may occur long after the original injury. Surgical treatment with bone grafting is necessary to repair a scaphoid nonunion.

#### 16. Mallet Finger

Mallet fingers are injuries to the extensor tendon of the finger near the DIP joint. They typically occur after a high velocity load to the end of the digit, such as when a ball hits the end of the finger leading to a stretch or rupture of the extensor tendon.

### Clinical Findings

Pain at the DIP joint with inability to actively extend the DIP joint is the usual presentation (Figure 9–8). Fractures may or may not be present.

![Figure 9–8. Mallet finger. Patient is asked to extend the fingers and is unable to extend the injured DIP joint.](image)

### Imaging & Diagnostic Studies

A lateral view of the phalanges can identify fractures and will determine if the joint is subluxated.

### Treatment

Most injuries do well with conservative treatment even if they are several months old. The DIP joint is splinted in extension full-time with a Mallet splint for 6–8 weeks. The splint allows time for the tendon to recover; if the finger is flexed during this time the splint period may have to be restarted. In the case of a fracture with joint subluxation, surgical pinning may be indicated.

#### 17. Phalangeal & Metacarpal Fractures

Fractures of the phalanges and metacarpals can occur after falls, a direct blow (such as punching a wall), or a twisting injury.

### Clinical Findings

Pain, swelling, ecchymosis, decreased range of motion, and deformity are common with these fractures. Patients should be carefully assessed for malrotation. In a normal hand, gentle flexion of the digits into the palm should result in no digital overlap and all the tips of the fingers should point to the area of the scaphoid. Fractures of the metacarpals or phalanges can result in loss of this normal “cascade” of the tips of the fingers, or malrotation, with overlap or scissoring onto the neighboring digits or deviation of the border digits away from the palm.

### Differential Diagnosis

Sprains, soft tissue contusions, and dislocations can have similar presentations and are readily distinguishable on radiographs.

### Imaging & Diagnostic Studies

PA, oblique, and lateral views of the hand should be taken to diagnose metacarpal fractures. Fractures of the phalanges are better visualized on dedicated views of the involved finger.

### Treatment

Treatment can vary depending on the displacement and type of fracture. Simple avulsion fractures can be treated with splinting or buddy-taping for pain. Nondisplaced metacarpal fractures or metacarpal fractures without malrotation or extensor lag can be treated with splinting or casting for 4–6 weeks. Phalangeal fractures treated conservatively are usually not immobilized for longer than 3–4 weeks because of the risk of permanent stiffness. Splinting or casting should be in the intrinsic plus position with the IPs extended and the MPs flexed 60–90 degrees, and should include the joint above and below the injury as well as the bordering digit(s). Fractures with malrotation, significant displacement, an unstable fracture pattern, significant shortening, joint involvement, or multiple fractures in the same hand are often treated surgically with closed reduction and pinning or open reduction and internal fixation.

#### 18. Radius or Ulnar Fractures

Fractures of the ulnar or radius usually result from a fall or trauma. In young patients, the trauma is usually fairly high energy. In osteoporotic patients it is often a fall from standing.

### Clinical Findings
Patients present with pain, swelling, ecchymosis, and deformity of the forearm or wrist. The skin should be carefully checked for any breaks that may indicate an open fracture. A careful neurovascular examination should also be performed.

**Differential Diagnosis**

Sprains and soft tissue injuries can have a similar presentation.

**Imaging & Diagnostic Studies**

PA and lateral views of the forearm or PA, lateral, and oblique views of the wrist should be obtained depending on the site of injury.

**Prevention**

Osteoporotic patients should be carefully treated and monitored to prevent these types of injuries. Forearm guards may be used in high-risk sporting activities such as martial arts.

**Treatment**

Almost all fractures of the radial shaft are treated surgically in adults. Isolated ulnar fractures can be treated with casting or splinting depending on location, displacement, and age of the patient. Distal radius fractures are treated with either casting or surgery again depending on the age of the patient, activity level, displacement of the fracture, and intra-articular involvement.

**REFERENCES**


**SELF-ASSESSMENT QUESTIONS**

Select the once correct answer for each question.

**Question 1:** SLAP (superior labral anterior to posterior) lesions
a. are tears that occur over the superior part of the labrum of the glenohumeral joint
b. may be called Bankart lesions if they have a positive O’Brien test
c. result from repetitive lifting motions
d. present with a deficit of internal rotation compared to the other side

**Question 2:** Shoulder dislocations
a. are caused by excessive force applied in any direction
b. are reduced by closed techniques with no particular urgency
c. are reduced solely by the Hippocratic maneuver
d. prevent full work for only a few days

**Question 3:** Acromioclavicular joint injuries
a. result from falls or from direct trauma to the arm or shoulder
b. stretch the ligaments of the acromioclavicular joint but spare the coracoacromial ligaments
c. cause pain and tenderness over the acromioclavicular joint but no deformity
d. have a distinctly different clinical appearance from clavicle fractures

**Question 4:** Thoracic outlet syndrome
a. is common but the diagnosis is missed frequently
b. is a set of symptoms and signs caused by compression of the neurovascular structures passing out of the chest and neck and beneath the clavicle to the axilla
c. affect men more frequently than women
d. usually occurs between the ages of 40 and 60

Question 5: Lateral humeral epicondylitis
a. is an acute inflammatory process
b. is an inflammation at the attachment of the extensor carpi radialis brevis to the lateral humeral epicondyle
c. can occur among workers who perform repeated forceful pinching or power grasps
d. occurs in those who work with the wrist in sustained flexion, or repeatedly move the wrist forcefully in flexion

Question 6: Radial nerve entrapment at the elbow
a. occurs when the sensory branch of the radial nerve is compressed
b. is characterized by pain that is 4 to 8 cm above the lateral epicondyle
c. results in pain that is aggravated by flexion of the middle finger
d. can be considered in cases of resistant lateral epicondylitis

Question 7: Ulnar nerve entrapment at the elbow
a. is less common than lateral humeral epicondylitis
b. is more common than carpal tunnel syndrome
c. may be related to old elbow injuries with enlarging osteophytes, cubitus valgus, or subluxation of the nerve out of the groove
d. is seldom work-related

Question 8: De Quervain tenosynovitis
a. causes pain in an ill-defined area along the ulnar side of the base of the thumb
b. results in localized tenderness over the ulnar side of the distal radius
c. is ruled out with a positive Finkelstein test
d. is usually associated with overuse of the thumb and wrist particularly with radial deviation, as in repetitive hammering, lifting, or pipetting

Question 9: Stenosing tenosynovitis of the flexor tendon to a finger of the flexor pollicis longus to the thumb
a. is usually caused by repetitive finger extension
b. is unrelated to systemic diseases such as diabetes, thyroid dysfunction, and rheumatoid arthritis
c. heralds the onset of osteoarthritis
d. may produce pain when the digit or thumb is forcibly flexed or extended

Question 10: Carpal tunnel syndrome
a. is an entrapment or pressure neuropathy of the ulnar nerve as it passes through the carpal tunnel
b. affects workers of any age but is more common in men
c. is not affected by pregnancy, increasing age, or obesity
d. is associated with repeated or sustained forceful gripping or repetitive wrist and finger movements involved in work

Question 11: Carpal tunnel syndrome
a. shows early evidence of thenar atrophy and loss of sensation
b. may lead to hand weakness if thyroid disease is present
c. is ruled out by a negative Phalen sign but a positive Tinel sign
d. is confirmed by median nerve electrodiagnostic studies

Question 12: Ulnar neuropathy at the wrist
a. causes weakness of the hypothenar, interosseous muscles, but no “clawing” of the hand
b. causes diminished sensation of the small finger only
c. can be caused by a space-occupying lesion in the area of Guyon canal
d. due to an occult mass rarely needs to be surgically treated to relieve the symptoms
Question 13: Hand arm vibration syndrome (HAVS)

a. is associated with the use of electric and pneumatic vibrating hand tools
b. clinical pathology is seldom confined to the distal upper extremity
c. occurs most commonly with outside work performed in warm climates
d. pain may be related to nerve compression or chronic soft tissue inflammation