Hand and Wrist Injuries

Sara W. Nelson and Michael A. Gibbs

An imaginary plane bisecting the third finger. The thumb has further planes of movement. In general, we refer to the digits by their numerical designations, but the common names are also acceptable—first (thumb), second (index finger), third (middle finger), fourth (ring finger), and fifth (little finger).

PRESENTING SIGNS AND SYMPTOMS

When assessing hand injuries, the history should focus on the mechanism of the injury, hand position at the time of the insult, perceived resultant functional impairment, and the time elapsed since the injury. Some mechanisms yield classic injury patterns, such as the jersey finger and mallet finger. Other injury patterns are known for their poor outcomes, such as fight bites or high-pressure injection injuries, and require specific managements. Some wounds are more prone to infection, such as crush injuries and grossly contaminated wounds.

During the history the patient’s hand dominance and career should also be ascertained and documented. Factors that may compromise wound healing, such as smoking, drug use, or an immunocompromised state, are important to document. Tetanus status should be verified.

Despite its complicated nature, the hand can be examined adequately in a short period. Developing a rapid, reproducible hand examination strategy and performing it regularly will decrease the chance of missing subtle injuries. Even when a specific injury is obvious, it is important to examine the entire hand to avoid overlooking less obvious, coincident injuries.

Box 89.1 lists one approach to comprehensive assessment of the hand.

Assuming that no active bleeding is occurring and requires immediate attention, examination of the hand begins with inspection. All rings, watches, and other potentially constricting devices should be removed immediately. Lacerations and other disruptions in skin integrity are usually recognized easily; erythema, soft tissue swelling, and ecchymoses should also be noted. It is important to compare the general position of the hand with that of the unaffected side inasmuch as many fractures or tendon disruptions will cause characteristic deformities that are recognizable on inspection.

Vascular integrity should be determined by comparing skin temperature with that of the opposite hand, feeling for ulnar and radial pulses, and documenting intact and symmetric distal capillary refill.
BOX 89.1 Two-Minute Hand Examination

**General**
- General appearance
- Obvious deformity

**Vascular**
- Hemorrhage control
- Ulnar and radial pulses
- Capillary refill less than 2 seconds

**Neurologic**
- Ulnar
  - Sensation: light touch distal, volar fifth digit
  - Motor: interosseous—abduction of the second digit
- Median
  - Sensation: light touch distal, volar second digit
  - Motor: thenar eminence—adduction of the first digit toward the ceiling
- Radial
  - Sensation: light touch to the dorsal web space between the second and third digits
  - Motor: wrist extension, otherwise sensation only in the hand
- Digital
  - Two-point discrimination—2 to 5 mm at the fingertip

**Musculoskeletal**
- Bony palpation of all digits and joints
- Active range of motion: make a fist; fully extend all digits
- Passive range of motion: passively take all digits and joints through all ranges
- Resistance: test all joints, all ranges with resistance to diagnose partial ligament injuries

**Ligamentous**
- Flexor digitorum profundus tendon—hold the proximal interphalangeal joint in extension; flex the distal interphalangeal joint against resistance
- Flexor digitorum sublunis tendon—hold the metacarpophalangeal joint in extension; flex the proximal interphalangeal joint against resistance
- Extensor tendons—place the hand palm down; extend the digit with resistance at the nail bed
- Ulnar collateral ligament—adduct the thumb against resistance

Neurologic testing should be performed before local or regional anesthesia. Radial, median, and ulnar nerve function should be individually assessed and the digital nerves interrogated via both light touch and two-point discrimination. Comparison with the unaffected side can be useful. To evaluate for radial neuropathy, the dorsal aspect of the second and third digits is assessed for decreased sensation. Proximal limb radial nerve lesions will cause wristdrop. However, the superficial radial nerve, as it courses through the hand, is sensory only. To test for median neuropathy, the distal, palmar surface of the second digit is assessed for decreased sensation. To test for ulnar neuropathy, the distal, palmar surface of the fifth digit is assessed for decreased sensation. Challenging the interosseous muscles best tests ulnar motor function. One method is to ask the patient to place the injured hand on a surface with the fifth digit down and the thumb pointing at the ceiling. The patient then abducts the second finger (spreads the fingers) against resistance; weakness of the first interosseous muscle verifies contraction.

Musculoskeletal assessment is targeted at identifying injuries to bones, joints, and ligaments. Bone structures should be palpated thoroughly, as should all joints, to look for signs of pain, laxity, and limited range of motion. Every digit and joint should be put through complete active and passive range of motion. All extensor and flexor tendons should be tested individually. Specific tendon function is evaluated by ranging every joint individually. Extensor tendon function is tested by extending all interphalangeal and metacarpophalangeal (MCP) joints against resistance. Flexor digitorum profundus tendon injury limits flexion at the distal interphalangeal (DIP) joint; its presence is confirmed by holding the proximal interphalangeal (PIP) and MCP joints in extension and flexing the DIP joint against resistance. Flexor digitorum sublunis tendon injury limits flexion at the PIP joint. This injury is confirmed by holding the MCP joint in extension and flexing the PIP joint against resistance. False-negative results occur if all the other digits are not held in complete extension. The uninjured thumb will have complete active range of motion without pain and should be able to oppose the fifth digit. Full flexion to a fist and full extension should be normal.

**DIFFERENTIAL DIAGNOSIS AND MEDICAL DECISION MAKING**

**FRACTURES OF THE HAND**

**Metacarpal Bone Fractures**

Metacarpal bone fractures cannot be discussed simply as a single group because of the vast differences in inherent mobility and function among them. For each, the tolerance for unreduced angulation varies. The first metacarpal is very mobile and fractures are relatively uncommon. Management includes proper reduction, placement of a thumb spica splint, and follow-up with hand surgery. The second and third metacarpals are the fixed center of the hand, and proper reduction of fractures is important for full return of function. The fourth and fifth metacarpals are more mobile and have greater ability to compensate for angular deformities. Hand surgery consultation is necessary for all metacarpal fractures; for unstable reductions; for irreducible, open, or intraarticular fractures; and for any fracture with rotational malalignment.

Metacarpal base fractures are uncommon and usually of little significance. The exception is at the base of the fifth metacarpal bone, where there can be associated subluxation of the metacarpal-hamate joint. The injured hand should be immobilized in an ulnar gutter splint and scheduled for referral to hand surgery.

**Bennett/Reverse Bennett and Rolando Fractures**

A Bennett fracture is a fracture of the proximal first metacarpal bone (Fig. 89.1). The classic mechanism is an axial load onto a flexed and adducted thumb. For example, a
injury is most frequently seen when a solid object is forcefully struck with a closed fist. True boxer’s fractures may carry significant morbidity because in addition to being an unstable fracture, the injury often has a rotational component. If allowed to heal in this position, the hand will be deformed and weakened.

ED management consists of an attempt at closed reduction and placement of a dorsal-volar splint. Regardless of the type of splint used, at a minimum the fourth and fifth MCP joints should be splinted at 90 degrees of flexion. Because of the instability of this fracture, all patients should be referred to a hand surgeon and warned of the significant likelihood that the injury will require operative management.

**Proximal and Middle Phalanx Fractures**

Proximal and middle phalanx fractures are managed similarly. The degree of instability depends on the nature of the fracture. Transverse and spiral fractures have greater instability than simple fractures do and are therefore more likely to require percutaneous fixation. It is important to keep in mind that rotational deformity cannot be tolerated. When the hand is held in a relaxed fist, the fingers should all point to the scaphoid region. Visible deviation from this plane suggests a rotational deformity of greater than 10%. All nondisplaced proximal and middle phalanx fractures should be splinted in the ED and referred for outpatient follow-up. Rotated, transverse, displaced, or intraarticular fractures should be reduced.
and splinted, and contemporaneous hand surgery consultation should be obtained.

**Distal Phalanx Fractures**

The most common distal phalanx fracture is a tuft fracture, and nail bed injuries are the most common complication of this fracture. There is some controversy regarding the need to repair nail bed injuries; however, most authors recommend performing trephination only for nail bed hematomas involving 30% to 50% or greater of the nail bed surface. When the nail bed is involved, tuft fractures are considered open fractures. Although some physicians prescribe antibiotics empirically, evidence suggests that prophylactic antibiotics are not indicated.

Proximal distal phalanx fractures are often unstable and require hand surgeon referral for percutaneous wire placement. An attempt to reduce any rotational deformity or angulation should be made before splinting. Splinting should isolate the DIP joint alone.

**Ligamentous Injuries of the Hand**

**de Quervain Tenosynovitis**

De Quervain tenosynovitis is an overuse injury of the thumb. The classic example of the mechanism is a fly fisherman who repetitively collects the line after each cast by using the thumb and index finger to grasp the line, thereby resulting in inflammation of the abductor pollicis longus and extensor pollicis brevis tendons. The diagnosis is made clinically, and a positive Finkelstein test is said to be pathognomonic. The Finkelstein test is considered positive when pain is elicited with passive ulnar deviation of a closed fist.

It is important to note that patients with this condition may complain of pain on palpation of the anatomic snuffbox because the aforementioned tendons form the radial border of that structure. If the history is suggestive of a possible scaphoid injury, radiography should be performed and a thumb spica splint applied. Treatment of simple de Quervain tenosynovitis consists of rest, application of ice, and nonsteroidal antiinflammatory drugs (NSAIDs); more severe cases may require splinting to rest the injured joint.

**Gamekeeper’s/Skier’s Thumb**

Gamekeeper’s thumb is also called skier’s thumb. The mechanism is hyperextension of an abducted thumb causing injury to the ulnar collateral ligament, and it is often associated with an avulsion fracture (Fig. 89.3). Historically, old-world gamekeepers sustained this injury while dispatching wounded birds during hunts. Today, this injury often occurs when a skier falls while grasping the ski pole.

Physical examination will be remarkable for tenderness at the ulnar collateral ligament, laxity at the MCP joint, and inability to actively oppose the thumb (Fig. 89.4). Most ulnar collateral ligament ruptures occur at the distal attachment. If the injured joint demonstrates 40 degrees of radial angulation during stressing, complete ligament rupture should be assumed. An associated avulsion fracture may be present. Treatment consists of immobilization in a thumb spica splint, NSAIDs, and referral to a hand surgeon for open reduction with internal fixation.

The initial examination may be compromised secondary to pain and spasm. In these cases, the most prudent course of action is immobilization in a thumb spica splint and referral for reevaluation.

**Jersey Finger**

Jersey finger is an injury often associated with tackling sports (Fig. 89.5). The injury itself consists of disruption of the flexor digitorum profundus joint, which is responsible for flexion of the digit at the DIP joint. It occurs when a digit (often the second digit) is forced into extension while actively being flexed, as might occur when grabbing an opponent’s jersey during a tackle.
On physical examination an injured patient will not be able to flex the digit at the DIP joint when the PIP joint is held (by the examiner) in extension. Examining the DIP joint without holding the PIP joint may result in a false-negative test result because of contribution from the lateral bands. The patient may complain of pain more proximally along the flexor tendon sheath or even in the palm because the ruptured flexor digitorum profundus tendon will retract. It is therefore imperative to challenge the distal joint despite only proximal pain. With full disruption the best outcomes depend on early surgical repair, and all patients should be scheduled for hand surgeon referral.

**Mallet Finger**

Mallet finger is in many ways the functional opposite of jersey finger. In mallet finger the distal extensor tendon is ruptured (Fig. 89.6). It often occurs when the distal phalanx of a finger (or thumb) is forced into flexion while being actively extended. In sports the middle finger is most often affected because of contribution from the lateral bands. The patient may complain of pain more proximally along the flexor tendon sheath or even in the palm because the ruptured flexor digitorum profundus tendon will retract. It is therefore imperative to challenge the distal joint despite only proximal pain. With full disruption the best outcomes depend on early surgical repair, and all patients should be scheduled for hand surgeon referral.

Dislocation of the DIP joint is a rare injury, but when it does occur, it most commonly dislocates in the dorsal direction after direct force on the finger pad. Relocation is best accomplished after a digital block with traction longitudinally and pressure directing the proximal aspect of the distal phalanx back to correct alignment. After relocation, the entire digit is splinted in extension. Some injuries are nonreducible and require operative repair because the volar plate or profundus tendon (or both) may occupy the joint space. Any indication of joint involvement should prompt referral to a hand surgeon.

**Digital Dislocations**

PPIP joint dislocations result in more complications than do DIP joint dislocations. The complex biomechanics of the joint adds a degree of intricacy that often results in the need for operative repair. The volar plate may be injured with dorsal dislocations, and the lateral collateral ligaments may be injured with ulnar or radial dislocations. It is important to assess any relocated joint for stability to better rule out the potential for ligament or volar plate injury. Patients with an irreducible or unstable joint should be referred to a hand surgeon for operative repair. If stable, the joint should be splinted in 30 degrees of flexion for 2 to 4 weeks.

**Extensor Tendon Injuries**

Open wounds on the dorsum of the hand and digits should trigger suspicion for extensor tendon injury. The Verdan extensor tendon injury classification system uses eight anatomic zones to direct treatment (Table 89.1).

Treatment of extensor tendon injuries should usually be coordinated with a hand surgeon. Data on suture repair of partial tendon lacerations are lacking, and current treatment is based on flexor tendon treatment. Conservative treatment of injuries involving less than 50% of a cross-sectional area has been proposed.

Injuries to zones I and II occur with axial loading onto a fully extended DIP joint, which forces the DIP joint into flexion and disrupts the distal aspect of the extensor tendon. This creates a mallet injury, as described previously.

Zone III injuries are caused either by axial loading and forced flexion of the PIP joint or by direct trauma to the PIP joint. These injuries should be splinted with the joint in extension, and the patient should be referred to a hand surgeon. With complete disruption of the central slip, the lateral bands slide toward the volar surface of the digit, which causes the extensor tendons to act as flexors. Untreated injuries lead to...

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**Table 89.1**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Extensor Tendon Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Fully extended DIP joint</td>
</tr>
<tr>
<td>II</td>
<td>Axial loading onto fully extended DIP joint</td>
</tr>
<tr>
<td>III</td>
<td>Axial loading and forced flexion of the PIP joint</td>
</tr>
<tr>
<td>IV</td>
<td>Direct trauma to the PIP joint</td>
</tr>
</tbody>
</table>

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**Footnotes:**

- A digital block with traction longitudinally and pressure directing the proximal aspect of the distal phalanx back to correct alignment. After relocation, the entire digit is splinted in extension. Some injuries are nonreducible and require operative repair because the volar plate or profundus tendon (or both) may occupy the joint space. Any indication of joint involvement should prompt referral to a hand surgeon.

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**References:**

a boutonnière deformity in which the PIP is flexed and the DIP is hyperextended.

Most zone IV injuries are caused by direct trauma. Open injuries may be treated primarily as in zone IV; by definition, no joint involvement is present. Closed injuries should be splinted with extension of the PIP joint. The extensor tendons of the phalanx are broad and flat, which allows easier primary repair.

“Fight bite” must be considered in all patients with zone V ligament injuries. Patients with open injuries should be referred to a hand surgeon for primary repair. Closed injuries can be treated by splinting the MCP joint in extension while allowing free range of motion of the PIP joint.

Zone VI injuries are usually superficial and easily repaired by the EP. Suture material should be strong, such as braided nylon, and the lacerated tendon completely apposed. After closure, the wrist should be splinted in 30 degrees of extension and the MCP joint in 15 degrees of flexion, and the PIP joint should be free. The patient should be referred to a specialist for dynamic splinting.

Zone VII and VIII injuries often involve the extensor retinaculum, and the patient should be scheduled for referral to a hand surgeon for primary closure. The affected tendon often retracts into the forearm, thus complicating the repair. Because of the density of associated anatomic structures, operative survey of the injury to identify additional injuries is indicated.

**Flexor Tendon Injuries**

All patients with open flexor tendon injuries should be referred to a hand surgeon for emergency evaluation (Table 89.2).

However, some knowledge of the nomenclature and prognoses associated with flexor tendon injuries will aid the EP in conversations with both the consultant and the patient.

Repair of complete lacerations within 24 hours is most commonly recommended. Operative repair is usually limited to injuries involving greater than 50% of a cross-sectional area. Injuries involving less than 50% are frequently treated conservatively with splinting. Newer data suggest that conservative management is adequate for injuries occupying less than 75% of a cross-sectional area; however, this decision should be deferred to the consulting hand surgeon. When splinting flexor tendon injuries, the wrist should be placed in 30 degrees of flexion, MCP joint injuries in 70 degrees of flexion, and DIP or PIP joint injuries in 10 degrees of flexion. Classification of flexor tendon injuries is based on anatomic location, treatment, and prognosis. All patients with flexor tendon injuries should be referred to a hand surgeon for operative exploration and repair.

**FRACTURES OF THE WRIST**

Carpal bone fractures can result in significant long-term morbidity and are easily missed during the physical examination. The two most common carpal fractures are fractures of the scaphoid and triquetrum. Scapholunate, perilunate, and lunate dislocations are the most common dislocations.

**Scaphoid Fractures**

The scaphoid is the most commonly injured carpal bone. A high index of suspicion is needed when considering this injury because plain film findings are often subtle or even absent (a dedicated scaphoid view will increase plain film sensitivity). The mechanism of injury is most often a fall onto an outstretched hand.

Morbidity is high with this injury because the bone is anatomically predisposed to avascular necrosis and nonunion. The blood supply to the scaphoid originates from the radial and palmar arteries and flows from distal to proximal. The

### Table 89.1 Verdan Classification of Extensor Tendon Injuries with Appropriate Disposition

<table>
<thead>
<tr>
<th>ZONE</th>
<th>ANATOMIC LOCATION</th>
<th>DISPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Distal phalanx to distal interphalangeal joint</td>
<td>Splint, hand surgeon referral</td>
</tr>
<tr>
<td>II</td>
<td>Middle phalanx</td>
<td>Splint, hand surgeon referral</td>
</tr>
<tr>
<td>III</td>
<td>Proximal interphalangeal joint</td>
<td>Splint, hand surgeon referral</td>
</tr>
<tr>
<td>IV</td>
<td>Proximal phalanx</td>
<td>ED primary repair, splint</td>
</tr>
<tr>
<td>V</td>
<td>Metacarpophalangeal joint</td>
<td>Splint, hand surgeon referral</td>
</tr>
<tr>
<td>VI</td>
<td>Dorsum of the hand/metacarpals</td>
<td>ED primary repair, splint</td>
</tr>
<tr>
<td>VII</td>
<td>Dorsum of the wrist, carpals</td>
<td>Hand surgeon primary repair</td>
</tr>
<tr>
<td>VIII</td>
<td>Distal forearm, proximal wrist</td>
<td>Hand surgeon primary repair</td>
</tr>
</tbody>
</table>


### Table 89.2 Verdan Classification of Flexor Tendon Injuries with Appropriate Disposition

<table>
<thead>
<tr>
<th>ZONE</th>
<th>ANATOMIC LOCATION</th>
<th>DISPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Distal to insertion of the flexor digitorum sublimis tendon</td>
<td>Hand surgeon primary repair</td>
</tr>
<tr>
<td>II</td>
<td>Area of the flexor sheath with both the flexor digitorum sublimis and flexor digitorum profundus tendons</td>
<td>Hand surgeon primary repair</td>
</tr>
<tr>
<td>III</td>
<td>Carpal tunnel to the proximal aspect of the flexor sheath</td>
<td>Hand surgeon primary repair</td>
</tr>
<tr>
<td>IV</td>
<td>Carpal tunnel</td>
<td>Hand surgeon primary repair</td>
</tr>
<tr>
<td>V</td>
<td>Forearm proximal to the carpal tunnel</td>
<td>Hand surgeon primary repair</td>
</tr>
</tbody>
</table>

most proximal aspect of the scaphoid receives blood only from this distal to proximal flow, and if this flow is interrupted by a fracture, the risk for avascular necrosis and nonunion is high. For this reason all patients with a traumatic mechanism and scaphoid tenderness, as assessed by palpation of the anatomic snuffbox or pain with axial loading of the thumb, should be treated with a thumb spica splint and referred for follow-up. Roughly 15% of these patients will have a scaphoid fracture despite unrevealing plain films.

**Triquetrum Fractures**

Triquetrum fractures are less common than scaphoid fractures but frequently have a similar mechanism of hyperextension. Most often the fracture is secondary to avulsion with an avulsion fragment noted at the dorsal aspect of the triquetrum. This is best seen on a lateral plain film projection. The prognosis is better than with scaphoid fractures because avascular necrosis is not a common occurrence with these injuries.

Occasionally, triquetrum body fractures can be seen; in this case the EP should look for associated lunate or perilunate dislocations. The wrist should be splinted and the patient referred to a hand surgeon for follow-up.

**DISLOCATIONS OF THE WRIST**

Scapholunate, perilunate, and lunate dislocations are varying degrees of the same disease process. The mechanism is one of hyperextension. In cadaver work it was shown that progressive force applied to the wrist in a hyperextension mechanism will reliably re-create these injuries in a persistent pattern. The reason is anatomically based and the result of progressive ligament injuries.

**Scapholunate Dislocation**

Scapholunate dislocation is the most common of these injuries and occurs with the least amount of force. It can be diagnosed on plain film radiography. Scapholunate dislocation results in a classic radiologic finding—the Terry-Thomas sign (Fig. 89.7). Terry-Thomas was a 20th-century British comedian who possessed a noticeable gap between his two front teeth, reminiscent of the wide space (2 mm when measured on an anteroposterior view) seen between the scaphoid and lunate bones when they are dislocated. Stress views accentuate this finding. Additionally, the scaphoid may twist on its axis and cause a ringlike shadow known as the signet ring sign. This artifact is caused by the x-rays traveling longitudinally down the twisted scaphoid, unlike the normal crosswise orientation. Mayfield et al. classified this injury as a stage I injury.

**Perilunate Dislocation**

Stage II injury is associated with progressively more force (e.g., an automobile accident versus a slip and fall) and results in perilunate dislocation (Fig. 89.8). Perilunate dislocations may be a difficult concept because there is no “perilunate” bone. Perilunate dislocation is a disruption of the ligamentous structures around (“peri”) the lunate bone. One of these structures is the capitate, which most often dislocates dorsally. Perilunate dislocation may perhaps better be called capitate dislocation; however, perilunate dislocation is actually a more accurate description of the stepwise disease process as outlined by Mayfield et al. Dislocation of the capitate can be associated with a scaphoid fracture. The EP should be diligent in assessing for one in the setting of the other. Perilunate dislocation is frequently overlooked despite the classic plain
film finding of the capitate and the remainder of the distal part of the hand lying dorsal to the lunate on the lateral projection.

**Triquetrum Dislocation**
Stage III injury involves dislocation of the triquetrum but is difficult to differentiate radiographically from stage II perilunate dislocation.

**Lunate Dislocation**
Stage IV injury is defined by the presence of a lunate dislocation. It is a complete disruption of the ligamentous structures of the wrist. In stage I the scaphoid dislocates from the lunate, in stages II and III the capitate and triquetrum dislocate from the lunate, and in stage IV the lunate dislocates from its articulation with the distal end of the radius. The dislocated capitate, which lies dorsal to the lunate, will often collapse onto the distal end of the radius as a result of muscular spasm because the lunate is no longer present to prevent such spasm.

The result is a distal radius and capitate pseudoarticulation, with the lunate lying palmar to the “new” wrist articulation. This is best viewed on a lateral plain film projection and causes the “spilled teacup” sign (Fig. 89.9). When teaching this concept, the author has asked students to imagine a watermelon seed being squeezed between two fingers and then popping forward with force. This is essentially what happens to the lunate as it is “squeezed” by the radius and distal wrist structures, including the capitate, in an extreme hyperextension mechanism. Lunate dislocation often compresses the carpal tunnel and can cause median neuropathy.

Plain film radiography is in general adequate to diagnose carpal bone dislocations, although computed tomography can be helpful in ambiguous cases. The EP may attempt closed reduction; however, many of these injuries are unstable. All injuries should be splinted in a long arm splint and patients should be referred to a hand surgeon. Many of these injuries will require internal fixation.

**Bites to the Hand**
Because of the potential for injury and morbidity, all open injuries of the MCP joint should be treated as closed-fist bite wounds, or “fight bites,” until proved otherwise. These often minor-appearing injuries are by definition caused by a clenched fist versus human teeth and are well known for poor outcomes. Potential complications include violation of the joint capsule, extensor tendon injury, and contamination of the deep fascial space. The potential for infection is great because of the poor vascular supply of the extensor tendon and joint capsule. Treatment of these injuries is threefold: surgical decontamination, antibiotics, and dynamic splinting. These injuries are not limited to fist fights and also commonly occur during sporting events.

Delayed manifestations most commonly occur 2 to 3 days after the inciting event and consist of signs and symptoms of local or significantly advanced infection. Any indication of infection or joint space or tendon sheath involvement should prompt referral to a hand surgeon for irrigation and débridement. The timing of initiation of intravenous antibiotics should be determined in consultation with the hand surgeon, who may wish to delay antibiotic treatment until after tissue...
for culture has been obtained intraoperatively. Antimicrobial therapy should cover common pathogens found in the human oral and skin flora, including aerobic and anaerobic pathogens. *Staphylococcus aureus* is the most common pathogen, followed by *Streptococcus* species, *Corynebacterium* species, and *Eikenella corrodens*.9

If the signs and symptoms are acute with no indication of fracture, joint space involvement, or extensor tendon injury, antibiotic therapy and local wound care are sufficient. In this nonoperative patient group, wounds should be treated with high-volume irrigation, and they should be left open to heal by secondary intention. The injured hand should be splinted in the position of function, and the patient should be instructed to elevate the affected limb and to return if any evidence of infection is seen.

Prophylactic antibiotics for clenched-fist bite wounds should be initiated for all but the most superficial injuries. Recommended regimens include amoxicillin–clavulanic acid, a combination of penicillin and dicloxacillin, and a combination of penicillin and a first-generation cephalosporin.9

**HIGH-PRESSURE INJECTION INJURIES**

High-pressure injection injuries occur when substances such as paint, oil, grease, solvents, and water are sprayed under high pressure. These substances can penetrate deeply into the soft tissues of the hand and cause inflammation, infection, fibrosis, and severe disability. In one series the rate of amputation approximated 50%, and when patients are initially seen more than 6 hours after the injury, amputations are the rule rather than the exception.9,10 Even a small puncture wound with a history of high-pressure injection should be considered a high-priority emergency.

Historical information, including time since the injury, the material injected, the amount injected, the temperature of the material, and the velocity and pressure of the injection may be helpful in determining the prognosis. For example, the amputation rate is considerably lower with grease injection than with injection of paint or solvent-based material. Thinner and less viscous material is more apt to lead to amputation because of easier spread and a subsequently larger extent of injury.

Plain film radiographs should be obtained to look for subcutaneous air and radiopaque material. The hand should be elevated and maintained in a position of comfort. Parenteral analgesics are often required. Infiltration of anesthetics directly into the area of injury may worsen local inflammation and is therefore contraindicated. All these injuries require immediate consultation with a hand surgeon. Even though several authors recommend prophylactic antibiotics and some suggest systemic corticosteroids to decrease inflammation, few data support either recommendation.

**TREATMENT**

Although individual hand and wrist injuries require specific treatment, several generalizable steps should be taken to optimize management in the ED.

**ANESTHESIA AND ANALGESIA**

The hand is densely innervated to increase tactile discrimination and complex function. Accordingly, hand injuries can be very painful. The decision to manage an injury by infiltration of a local anesthetic, a regional anesthetic technique, oral or parenteral analgesics, or a combination of these approaches will vary. It is worth noting that the hand is highly amenable to regional anesthetic techniques that can be mastered quickly by EPs with a bit of practice. Local and regional anesthesia is discussed in Chapter 10. A number of instructional websites also provide detailed information on these techniques, including a site developed at our institution (see www.mmc.org/em_body.cfm?id=3235).

**TREATMENT OF OPEN WOUNDS**

Unless a plan for intraoperative washout is in place, all open hand and wrist injuries should undergo meticulous irrigation. When performing irrigation, a 60-mL syringe and an 18-gauge angiocatheter or splashguard device will generate the proper irrigation pressure. No study has shown any benefit of wound soaking or the use of antiseptic solution during irrigation. Tap water irrigation has proved to be as safe as irrigation with sterile solutions.9 As a rule, patients with all but the most minor hand injuries should receive prophylactic antibiotics.

**SPLINTING**

For almost every hand and wrist injury, the most important last step is effective splinting. Splinting decreases pain, speeds healing, and reduces the likelihood of fracture displacement.

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**TIPS AND TRICKS**

Regional anesthesia of the median, radial, and ulnar nerves can easily be mastered. These techniques improve the patient’s comfort and the physician’s ability to assess and manage injury.

Use plain radiography to assess for air or radiopaque material in patients suffering high-pressure injection injuries.

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**RED FLAGS**

**Cautions for Physicians**

Do not cut corners during physical examination of the hand. This will invariably lead to misdiagnosis, mistreatment, and loss of function.

All lacerations involving the extensor surface of the hand are “fight bites” until proved otherwise. Never accept the history at face value when the injury pattern is suspicious.

In patients with a history of high-pressure injection injuries, do not be fooled by a seemingly innocuous skin puncture wound.

Failure to immobilize, failure to consult, and failure to arrange timely follow-up are common avoidable pitfalls in the management of hand and wrist injuries.
Digital injuries can usually be managed with a simple aluminum finger splint. When the injuries are unstable, more complete immobilization of the hand and wrist is recommended. Splinting of the hand should preserve the “position of function”—that is, extension at the wrist, flexion at the MCP joint, and nearly complete extension of the PIP and DIP joints. The objective is to maintain an appropriate amount of tension on ligaments that may shorten over time if relaxed. The position of function can be achieved by asking the patient to hold the hand as though holding a tennis ball and facing it forward.

**HAND DOMINANCE, THE PROFESSION OF THE PATIENT, AND THE TIMING AND MECHANISM OF INJURY ARE ESSENTIAL ELEMENTS OF THE HISTORY IN PATIENTS WITH HAND AND WRIST INJURIES.**

“Neurovascular intact” is not enough for a hand injury! Documentation should carefully reflect assessment of the pulses and capillary refill. Motor and sensory function of the median, radial, and ulnar nerves should be individually tested and documented.

Because follow-up is such a crucial element in the management of hand and wrist injuries, documentation of phone consultation and agreed-on decisions for definitive management should be explicitly documented.

**FOLLOW-UP, NEXT STEPS IN CARE, AND PATIENT EDUCATION**

The vast majority of hand injuries are amenable to outpatient follow-up. Care pathways should be established between the ED and hand surgeons to ensure that patients are not lost to follow-up when follow-up is vital. A relatively small subset of acute hand injuries will require immediate operative repair (e.g., vascular injuries with compromised perfusion, major crush injuries, amputations) or washout in the operating room (e.g., open fractures and joint injuries, grossly contaminated soft tissue injuries, high-pressure injection injuries, bite wounds at high risk for infection). When in doubt, the EP should not hesitate to obtain phone consultation or call a colleague to the bedside.

**SUGGESTED READINGS**


**REFERENCES**

References can be found on Expert Consult @ www.expertconsult.com.
REFERENCES