Soft Tissue Injury
Matthew R. Levine and Navneet Cheema

Open wounds are frequent reasons for emergency department (ED) visits. The true incidence of foreign bodies (FBs) in wounds is unknown, but with more than 5 million estimated lacerations repaired in EDs in 2007, wound FBs surely occur in such a significant number that all emergency physicians (EPs) will encounter them. Wound FBs are frequently missed on initial evaluation. Seventy-five of 200 FBs encountered in a hand clinic were missed by the initial physician. Furthermore, missed FBs pose high medicolegal risk for EPs, with one report listing it to be among the top three causes of litigation after wound care.

Most wound FBs are wood, glass, or metal. The upper extremity is the most common location (58%), followed by the lower extremity (36%). The head and neck (4%) and the trunk (1%) are far less common. Most cases will be seen on the day of injury (75%), but some (8.7%) will initially be evaluated weeks, months, or years later.

PATHOPHYSIOLOGY
A retained FB can lay harmlessly dormant for a long period and then react with surrounding tissue. When a tissue reaction occurs, several sequelae are possible. An infection may occur. The patient’s body may dissolve, extrude, or encapsulate the FB and form a granuloma, and subsequent rupture of the granuloma from minor trauma can cause delayed infection. The extent of tissue reaction depends primarily on the chemical composition of the material. Inert material causes less tissue inflammation, whereas reactive material can cause intense tissue reactions (Box 187.1) and rarely even allergic reactions. Even when an FB does not cause a tissue reaction, it can have other effects. The FB may cause local compression on neighboring structures such as nerves, tendons, joints, or vessels, thereby causing pain or structural damage. Local migration or, more rarely, distant embolization can also occur.

The most threatening FBs are reactive. Wood is especially toxic to soft tissue and virtually always requires removal. FBs causing infection and pain and FBs that are near vital structures such as nerves, tendons, vessels, and joints are also potentially dangerous. Hand FBs tend to migrate locally but rarely embolize, whereas proximal forearm FBs are more likely to embolize.

PRESENTING SIGNS AND SYMPTOMS
The classic example of a wound FB is a patient who sees or knows that foreign material is present in a wound, such as a splinter, glass in the sole of the foot that the patient cannot remove, or an obviously soiled wound. Alternatively, it is also

KEY POINTS
- Retained foreign bodies (FBs) can cause pain, infection, delayed healing, nerve and tendon injury, masses, and functional impairment.
- Specific injuries, such as those caused by broken glass or surfaces with gravel and stepping on objects, are particularly prone to retained FBs.
- Wounds should be explored for FBs with adequate anesthesia and lighting in a bloodless field.
- Plain radiographs are useful in evaluating for radiopaque FBs and should be ordered commonly.
- Plain films may miss nonradiopaque FBs such as wood, plastic, and vegetative matter. They may also miss radiopaque FBs that are tiny, obscured by bone, or in areas that are difficult to obtain quality images, such as the face or sole of the foot.
- Ultrasound scans and portable fluoroscopic studies may aid in localization and removal of FBs. Computed tomography and magnetic resonance imaging are rarely indicated.
- Neither exploration nor imaging alone can rule out an FB. The two should be used in combination in most instances. No wound is too small or superficial to harbor an FB.
- Careful discharge instructions are crucial and can minimize the morbidity and medicolegal risk associated with retained FBs. Patients should be informed that it is impossible to detect all FBs, be told what to expect in the event of a missed FB, and be given appropriate referral should these circumstances arise.
- Direct exploration of wounds plus visualization of tendons placed through a full range of motion is necessary for proper evaluation of tendon injuries.
- A detailed neurovascular examination is required to identify possible nerve lacerations.
- Most tendon and nerve lacerations can be repaired on an outpatient basis. Ensuring appropriate and timely follow-up is important.

RETIRED FOREIGN BODIES

EPIDEMIOLOGY
Open wounds are frequent reasons for emergency department (ED) visits. The true incidence of foreign bodies (FBs) in
common for a patient to have a wound and not to know that foreign material is present. The chief complaint of such patients is simply that they have a wound. Certain mechanisms are highly suggestive of wound FBs (Box 187.2). Some unique wound FBs include shrapnel, fishhooks, bullets and BBs, cactus spines, and marine material (Table 187.1). Some patients may exhibit sequelae of a retained FB from the near or distant past, such as a mass, persistent pain, infection, functional impairment as a result of nerve or tendon injury, arthritis, vascular injury, or embolization.

Neither the presence nor the absence of FB sensation on the part of the patient can confidently rule in or exclude an FB. In a series of 164 wounds caused by glass, 41% that contained glass caused an FB sensation, with a positive predictive value of 31% and a negative predictive value of 89%.5

The most important aspect of the physical examination is wound exploration. The wound should be explored in a bloodless field, which may require tourniquets or lidocaine with epinephrine infiltration if direct pressure is insufficient. Adequate anesthesia is crucial. The wound should be visualized completely and with range of motion of the involved digit. The wound can be probed with an instrument. Sometimes an FB is detected only by the grating sound of a metal probe against it. Probing the wound with the examiner’s finger exposes the examiner to puncture wounds and should not be done. The wound can be palpated through the skin with two hands, one stationary as a “stabilizer” and the other mobile as a “mover.” Puncture wounds should be palpated for the exquisite tenderness that may be elicited in the presence of an FB. The function of nearby nerves and tendons should also be evaluated.

**DIFFERENTIAL DIAGNOSIS AND MEDICAL DECISION MAKING**

No wound is too small or superficial to harbor an FB, and thus the possibility of an FB must be considered for all wounds. Most wound FBs are initially diagnosed by physical

<table>
<thead>
<tr>
<th>Inert Foreign Bodies</th>
<th>Reactive Foreign Bodies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass</td>
<td>Wood</td>
</tr>
<tr>
<td>Most metals</td>
<td>Thorns</td>
</tr>
<tr>
<td>Plastic</td>
<td>Other vegetative matter</td>
</tr>
<tr>
<td></td>
<td>Clothing</td>
</tr>
<tr>
<td></td>
<td>Skin fragments</td>
</tr>
</tbody>
</table>

**Box 187.2 Scenarios Suggestive of Foreign Bodies in Wounds**

- History of stepping on glass
- History of punching through a window
- Motor vehicle collision wounds from glass
- Wounds on the sole of the foot
- Puncture wounds
- Head wounds from glass
- Objects that fragment while in one’s hand
- Fall onto gravel or soil
- Pain at a site of intravenous drug use
- Foot laceration while walking in a stream
- Wound infection, especially if persistent
- Perioral wounds in the presence of broken teeth
- Persistent wound pain
- Failure to heal, persistently draining wound

---

**Table 187.1 Treatment—Special Circumstances**

<table>
<thead>
<tr>
<th>TYPE OF FOREIGN BODY</th>
<th>TIPS AND COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishhooks</td>
<td>Anesthetize the area, advance the tip of the fishhook through the skin, cut the barb, and withdraw the hook.</td>
</tr>
<tr>
<td>Splinters</td>
<td>Do not pull long splinters out because they tend to fragment. Instead, excise along the long axis or elliptically.</td>
</tr>
<tr>
<td>Needle tips</td>
<td>Removal may require excision of a block of tissue.</td>
</tr>
<tr>
<td>Shrapnel</td>
<td>When extensive, emergency department removal of all shrapnel may not be feasible or indicated. Remove as much as reasonably possible, with a focus on dangerous locations, and refer the patient for further treatment.</td>
</tr>
<tr>
<td>Bullets, BBs</td>
<td>These items are often left in situ, but objects larger than 4.5 mm in diameter tend to track skin and clothing into wounds, so visualize, irrigate, and leave open when possible. Remove these objects only if they are easily accessible or in the pleura (risk for lead poisoning).</td>
</tr>
<tr>
<td>Cactus spines</td>
<td>Use fine-tipped forceps or glue to remove them.</td>
</tr>
<tr>
<td>Marine envenomations</td>
<td>Treatment (hot water immersion, vinegar, shaving) depends on the type of spine or nematocyst.</td>
</tr>
<tr>
<td>Traumatic tattooing</td>
<td>Sources include pencils and blacktop. Débride with a scrub brush. Management is difficult. Consider referral to dermatology or plastic surgery for dermabrasion or laser treatment.</td>
</tr>
</tbody>
</table>
examination (78%), but many are diagnosed primarily by imaging studies (22%).

Exploration alone is insufficient to rule out an FB, even when the entire wound is thought to be visualized. Therefore, imaging should be used liberally. Selection of the proper imaging modalities requires knowledge of the radiographic properties of the material (Box 187.3 and Figs. 187.1 through 187.3). Even when a suspected FB is not radiopaque, plain film radiographs with an underpenetrated soft tissue technique could be considered because other useful soft tissue or bony findings and reactions may be present. Furthermore, failure to order radiographs has been associated with unsuccessful legal defense in cases of retained FBs. Ultrasound scanning is particularly useful for nonradiopaque FBs (Fig. 187.4). Low-power portable fluoroscopy, when available, is useful to aid in removal of radiopaque FBs. Computed tomography and magnetic resonance imaging are rarely indicated. However, computed tomography may be useful for ocular or periorbital FBs (Table 187.2).

After an FB is diagnosed, the next step is to decide whether to attempt removal or to leave the FB in place. Not all FBs require removal. If an FB is deep, small, inert, away from vital structures, and asymptomatic, attempts at removal may be more destructive than helpful (Box 187.4). Irrigation is an important intervention that not only cleans the wound but also often removes tiny FBs and particulate matter that would otherwise be difficult to localize.

**Box 187.3 Radiopaque and Nonradiopaque Foreign Bodies**

**Radiopaque Foreign Bodies**
- Glass
- Metal
- Bone
- Teeth
- Pencil tips, graphite
- Gravel

**Nonradiopaque Foreign Bodies**
- Wood (only 15% seen on radiographs)
- Most plastic
- Thorns
- Cactus spines
- Vegetative matter

**Fig. 187.1** This patient had a laceration over the olecranon after a motor vehicle collision. A radiograph reveals a foreign body (A). A piece of glass was removed (B).

**Fig. 187.2** This patient sustained multiple superficial wounds to the sole of the foot while running barefoot through gravel. A radiograph performed after all gross material was removed revealed two residual foreign bodies (arrows). The bits of gravel were removed.

**Fig. 187.3** This patient stepped on broken glass (A). The radiograph, when magnified and scrutinized, showed a possible foreign body (arrow) in the proximity of the wound (B). The wound was explored and a glass foreign body was removed (C). This is an example of the limitations of radiographs for detection of foreign bodies, even those that are radiopaque, in certain locations such as the sole of the foot because of the thickened tissue and multiple bony structures that may obscure the foreign body. This is why wound exploration is also important.
Exploration is best done while the EP is seated comfortably with optimal anesthesia, hemostasis, lighting (even headlamps), and equipment. Fine-tipped forceps, retractors, special pickups, and magnifying loupes are particularly helpful. Many explorations require extending the incision for better exposure. The EP should listen during probing for a grating sound of the FB against the instrument. Blind grasping is destructive to tissue and should be avoided. The use of portable fluoroscopy or ultrasound scanning, if readily available, should be considered to facilitate removal. A time limit for the procedure should be set in advance because it is easy to become involved and determined to recover an FB that may be too difficult to remove in the ED setting. The patient should be aware of this time limit.

Wounds that are contaminated or may still contain FBs should be left open or packed. Antibiotics should probably be prescribed for these patients. EPs should be sure to pad or splint areas with retained FBs before patients are discharged. If all FBs have been removed and the wound has been thoroughly cleansed, closure may be appropriate. An algorithm for an approach to FBs is presented in Figure 187.5.

If all FBs have been removed and the wound has been cleaned adequately, the patient is unlikely to require further referral. If concern still exists about a retained FB, the area should be padded or splinted, antibiotics should be prescribed.

Fig. 187.4 Ultrasound scan showing a wood foreign body with characteristic acoustic shadowing deep to the foreign body.

| Table 187.2 Features of Available Imaging Techniques |
|---------------------------------|-------------------|-------------------|
| **IMAGING MODALITY** | **POSITIVE FEATURES** | **NEGATIVE FEATURES** |
| Radiography | Inexpensive | Misses nonradiopaque foreign bodies |
| | Easy to obtain and read | Sensitivity falls for objects <2 mm |
| | 99% sensitive for radiopaque objects >2 mm* | Two-dimensional still picture may not aid in removal |
| Ultrasound | Detects all materials† | Operator dependent |
| | Live bedside images may aid removal | Gel complicates use during removal of foreign bodies |
| | Consider for wood, plastic | Difficult in large open wounds, web spaces |
| | No radiation exposure | False-positive results: sesamoids, calcification |
| | | False-negative results: gas, hematoma, near bone or scar |
| Portable fluoroscopy | Low radiation exposure | Misses nonradiopaque foreign bodies |
| | Can aid in real-time removal | Often limited availability |
| | For difficult removal of radiopaque foreign bodies | |
| Computed tomography | Good for periorbital, intraocular, intracranial foreign bodies | Costly |
| | May help in bony areas | Impractical |
| | High resolution may enhance detection | More radiation exposure |
| Magnetic resonance imaging | May help for some difficult plastic foreign bodies | Costly |
| | High resolution may enhance detection | Impractical |
| | No radiation exposure | Potential harm if metal foreign body present |

and the patient will require consultation or referral to a surgical specialty such as hand, orthopedic, plastic, or general surgery. Such referral can almost always take place on an outpatient basis unless severe infection or important structural damage is present.

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

Admission is seldom indicated. Admission scenarios may include severe infections and FBs that are going to be removed in the operating room. Documentation and patient education are important aspects of all wound cases. (See the “Documentation”, “Patient Teaching Tips”, “Red Flags”, and “Priority Actions” boxes.)

**TENDON AND NERVE LACERATIONS**

**EPIDEMIOLOGY**

Lacerations are one of the most common chief complaints of patients seen in the ED. It is estimated that a total of
6,400,000 open wounds were treated in EDs in the United States in 2004, thereby making open wounds anywhere on the body the third leading primary diagnosis group. Approximately one third of all open wounds are located on the upper extremity (specifically the fingers, hand, or wrist). An improperly functioning or insensate digit as a result of tendon or nerve injury can lead to markedly impaired function and significant subsequent morbidity. Wound claims, particularly of the hand, are a leading cause of litigation. Although lacerations about the foot and ankle are also relatively common, given the importance and prevalence of hand injuries, this part of the chapter focuses primarily on tendon and nerve lacerations of the hand.

**DOCUMENTATION**

**Soft Tissue Injury**

**History**
Detailed mechanism, hand dominance, timing, type of material, whether the object broke on impact or was already broken, whether the wound was soiled, whether anything was pulled out of the wound, FB sensation, paresthesia, weakness, tetanus immunization status, medical conditions that may impair healing or compromise immune function, intravenous drug use, and persistent pain, infection, or drainage

**Physical Examination**
Position of the hand at rest, detailed neurovascular examination including two-point discrimination, ability to achieve active range of motion and the presence of pain with passive motion, wound size and depth, tenderness, visible contaminants, infection, tattooing, discoloration, signs of infection, and masses

**Studies**
Documentation of radiographic results before and after removal of FBs or any other injuries

**Medical Decision Making**
Reasons to pursue or not pursue FB work-up, factors involved in attempting FB removal or leaving in place, and referral or consultation

Documentation of reasons to refer to a surgeon on an outpatient basis and discussion of the case with the referring physician

**Procedures**
Documentation of whether the entire extent of the wound base was visualized in a bloodless field with adequate anesthesia and the tendon was visualized through full range of motion (when appropriate)

**Patient Instructions**
Documentation of discussion with the patient regarding the possibility of a retained FB, tendon or nerve injury, warning signs, what to do, when to return, and when follow-up should occur

**PATIENT TEACHING TIPS**

Inform patients with wounds of the remote possibility of a missed foreign body because there is no way to truly guarantee that all foreign material has been identified and removed.

After the first couple days, a normal wound should show consistently gradual improvement in pain, swelling, and discoloration.

Inform patients that a retained foreign body may result in persistent pain, loss or impairment of function, a mass, infection, or injury to a nerve, tendon, vessel, or joint. These complications may develop even months or years later.

If any of the foregoing situations develop, the patient should know to return to the emergency department or should have received specialty referral.

Warn the patient to return for signs of infection, including redness, discharge, pain, and swelling.

Warn patients who have documented partial tendon lacerations, depending on the degree of laceration and findings on subsequent examination, that the referring physician may or may not repair the injury.

Inform all patients of the possibility of tendon or nerve lacerations not visualized on examination.

If a nerve or tendon laceration has been documented, ensure that the patient understands the importance of timely follow-up.

**RED FLAGS**

**Complications of Retained Foreign Bodies**
Infection, possibly recurrent
Persistent pain
Functional impairment
Granuloma formation
Psychologic distress
Migration, embolization
Delayed healing
Nerve, tendon, joint, vascular injury

**PRIORITY ACTIONS**

Maintaining a High Index of Suspicion for Foreign Bodies in All Wounds
Appropriate use of imaging
Wound exploration
Decision whether to attempt removal of the foreign body in the emergency department
High-pressure irrigation, wound cleansing
Appropriate use of antibiotics
Specialty referral, consultation for retained foreign bodies
Proper discharge instructions
PATHOPHYSIOLOGY

The hand is one of the most multifaceted and complex musculoskeletal systems in the body. The precision and fine motor functions of the hand are a direct result of its intricate structure. The frequency and importance of hand injuries necessitate that EPs have a thorough understanding of the anatomic and functional complexity of the hand.

The nerve supply to the hand is provided by the radial, ulnar, and median nerves. The radial nerve is purely sensory in the hand (motor function of the radial nerve includes wrist extension). The median and ulnar nerves provide the entire motor function of the hand and some sensory function as well (Fig. 187.6). Each digit has two neurovascular bundles located near the palmar aspect of the finger, one on the radial side and the other on the ulnar side.

The extensor tendons are located on the dorsal surface of the forearm, wrist, and hand. Nine extensor tendons pass under the extensor retinaculum. The extensor tendons join to become the extensor expansion and then separate into six fibroosseous compartments. In each digit, the extensor expansion then divides into a central slip attaching to the middle phalanx and two lateral bands joining with the tendons of the lumbricals and then continuing on to attach to the base of each distal phalanx. See Figure 187.7 for extensor tendon zone classification.

The flexor tendons are located on the volar side of the forearm, wrist, and hand. A single tendon (the flexor pollicis longus) inserts on the distal phalanx of the thumb, and two flexor tendons go to each of the remainder digits. Each digit has a superficial flexor tendon that inserts at the base of the middle phalanx and a deep flexor tendon that inserts at the base of the distal phalanx.

The superficial location of the tendons and nerves of the hand combined with the lack of overlying subcutaneous tissue predisposes these structures to injury. Injuries to the tendons have been grouped into anatomic zones for easy understanding and classification. The most widely accepted classification system is that of Verdan. This system uses eight zones, from zone I at the distal interphalangeal joint level to zone VIII at the distal forearm level. This system has been modified to five zones for the flexor tendons (Fig. 187.8). Although the Verdan system is no longer used to determine treatment options, knowledge of the zones is useful for prognosis.
PRESENTING SIGNS AND SYMPTOMS

Any patient with a laceration about the hand or wrist may have sustained a tendon or nerve laceration regardless of how superficial the wound may appear. In a study of 226 patients with upper extremity lacerations that were less than 2 cm in length, 59% were found to have at least one injury to a deep structure. Depending on the degree of injury, the patient may have no obvious injury other than a laceration through the skin.

Patients with nerve lacerations typically have a complaint of numbness or tingling distal to the laceration. In cases of injury to the radial, ulnar, or median nerves, the corresponding motor distribution is affected. Unless a motor deficit is noted, the clinical finding of a nerve injury may easily be missed.

The normal resting position of the hand—flexed fingers, with the little finger having the greatest degree of flexion and the index finger the least—may be altered in patients with a complete tendon laceration (Fig. 187.9). Flexor tendon disruption is indicated when the injured finger lies in complete extension while the others are in slight flexion. When the patient has an extensor tendon injury, the affected digit is held in full flexion while the others are held in slight extension or the normal position of function. Partial lacerations may not be evident based on the position of the finger. Limited or painful movement, especially if more severe than would be expected with the laceration, suggests partial tendon involvement.

DIFFERENTIAL DIAGNOSIS AND MEDICAL DECISION MAKING

The most important aspects of the diagnosis of tendon or nerve laceration are a thorough history and physical examination. Basic historical details should include the time and mechanism of injury, position of the hand when injured, hand dominance, tetanus status, previous hand injuries, and occupation and hobbies (musician or anyone requiring fine motor control). Patients should be specifically asked about loss of motion, weakness, pain, and any numbness or tingling.

Examination of the hand begins with an overall assessment of the position of the hand and fingers. Pallor, gross deformity, or digits lying in abnormal positions should be noted and compared with the other fingers and hand. Next, the sensation and motor strength of the hand should be assessed to detect nerve injury. As stated previously, the radial, ulnar, and median nerves provide sensation to the hand. Because of the overlap in sensory innervation, it is best to test nerves in the area least likely to have dual innervation. The median nerve is tested at the palmar surface of the index finger, the ulnar nerve at the palmar surface of the little finger, and the radial nerve at the dorsal surface of the web space between the thumb and index finger.

Various stimuli can be used to test sensory function of the hand. Gross touch with a blunt object is the least specific. It can be useful for rapid screening to test for nerve injury, especially when compared with the other hand. A more accurate method for assessing nerve function is two-point discrimination. A paper clip can be used. A patient with a normally innervated fingertip should be able to distinguish two simultaneously delivered stimuli 6 mm or more apart from each other. Most patients can detect a difference down to 3 mm. When identification of stimuli separated by 8 mm or more is not reported by the patient, the examination is clearly abnormal.

Accurate evaluation of two-point discrimination to assess for nerve injury is not always possible at the time of injury. The patient’s pain and anxiety, as well as factors such as the presence of hand calluses, can interfere with this test. Any subjective “numbness” reported by the patient must be taken seriously, and consultation with a hand specialist should be considered. Under these circumstances, it is common to close the skin wound and refer the patient for evaluation within a few days of the initial injury.

A systematic examination of the hand and wrist includes assessment of active and passive range of motion of the wrist and digits. To check specifically for extensor tendon injuries, the patient should actively extend each finger and then extend each finger against resistance. In evaluating the flexor tendons, the superficialis and profundus tendons should be tested independently, with the patient actively flexing individual proximal and distal interphalangeal joints (Fig. 187.10). Examiners...
should be sure to check tendon motion against resistance because patients with partial tendon lacerations may have normal range of motion.

The next step is exploration of the wound (Fig. 187.11), which is best done with the EP seated comfortably with optimal anesthesia, hemostasis, lighting, and equipment. Adequate anesthesia is crucial. Failure to provide adequate exposure of deeper wound structures because of the patient’s discomfort often leads to missed injuries. The wound should be explored in a bloodless field. A tourniquet may be required if direct pressure is insufficient to achieve such a field. The wound should be visualized completely and with full range of motion of the involved digit.

Additional studies or imaging techniques are indicated to evaluate for FBs, fractures, and avulsions. They are not useful in evaluating tendon or nerve lacerations. Ultrasonography may be a viable diagnostic tool in evaluating tendon injuries, although at this time it has not been studied in the ED.  

**TREATMENT**

All motor branches of the ulnar and median nerve should be repaired. Both consultation in the ED and referral the following day after discussion with the referring physician are appropriate (Box 187.5). Digital nerve injuries proximal to the distal interphalangeal crease on the radial aspect of the index and middle fingers, the ulnar side of the little finger, and both sides of the thumb should be repaired. The timing of repair for simple, clean nerve injuries is somewhat controversial; some data show better results with repair in 6 to 12 hours, whereas other data show acceptable results with delayed repair. Satisfactory return of function can occur after nerve repair or a graft performed within 3 months of injury. Any patient with a suspected nerve injury should be referred to a specialist for evaluation and possible repair.

Patients with tendon lacerations (partial or complete) require early referral to a surgeon. Most surgeons recommend repairing complete lacerations primarily within 12 to 24 hours after the injury. However, data on delayed primary (<10 days) or early secondary (2 to 4 weeks) repair show little difference in outcomes when compared with the traditional immediate repair. Repair of partial tendon lacerations is still controversial, and most hand surgeons now repair only lacerations that involve more than 50% of the tendon surface. Regardless of whether the laceration is full or partial, primary coverage of the injured tendon by skin suturing after wound irrigation protects the tendon and retards infection, but it should be undertaken only after consultation with the specialist who will perform the definitive repair.

Extensor tendon injuries are underestimated by EPs. Because of the superficial location and thin overlying subcutaneous tissue, these tendons are often injured. Their superficial location makes repair easier; in the past, these injuries have been repaired by EPs, although it is generally best to coordinate with a surgeon willing to provide repair and follow-up. Zones VII and VIII are associated with significant retraction of tendons, and given the proximity of many tendons, multiple tendons may be injured. Therefore, injuries to tendons in these zones are more difficult to repair and may have worse outcomes.

Flexor tendon injuries are more difficult to repair. These injuries are more complicated because both superficial and deep tendons are present and both may be injured. Injuries in zones II and IV have a much worse prognosis as a result of the propensity to form adhesions within a confined space. Overall, ED consultation with a specialist or early referral after discussion with the specialist who will perform the definitive repair should be ensured for any confirmed nerve or tendon injury (extensor and flexor), overlying lacerations should generally be sutured after discussion with the definitive treating physician, a splint should be applied, and the EP should consider antibiotic coverage if appropriate.

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

Most patients with tendon and nerve lacerations can be discharged home safely from the ED. Educating the patient regarding expectations and the importance of follow-up is of utmost importance. All patients with documented or suspected lacerations of a tendon or nerve require evaluation by the appropriate surgeon. ED consultation and early referral following discussion with a specialist are both appropriate.
courses of action. If severe infection or important structural damage is present, ED consultation may be more prudent than outpatient follow-up. The area should be splinted appropriately and antibiotics prescribed if indicated. Flexor injuries should be splinted with the wrist in 30 degrees of flexion, the metacarpophalangeal joints flexed 70 degrees, and the interphalangeal joints flexed 10 to 15 degrees. A metal protective splint is recommended for patients who are going to return to work. All but very minor hand wounds are best followed up within 48 hours for removal of the dressing and inspection of the wound for signs of infection. (See Box 187.6 for complications.)

**BOX 187.6 Complications of Tendon Injury**

- Triggering
- Synovial adhesions
- Entrapment
- Delayed tendon rupture

**REFERENCES**

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