Traumatic Hand Injuries: The Emergency Clinician’s Evidence-Based Approach

At the start of your Saturday afternoon shift, you are not surprised to see that several patients are waiting to be seen for physical injuries. The first patient is a 34-year-old woman who sustained injury to her hand while skiing, 2 hours prior to her arrival. She reports falling with her hand still tethered to the pole’s grip, landing on her outstretched right hand. She felt a painful snap in her right thumb, which still hurts, but otherwise she did not sustain any other trauma. Her only complaint currently is pain at the base of the right thumb. The patient is otherwise completely healthy, has no past medical or surgical history, and takes no medications. Upon examination, the affected hand appears to be surprisingly normal except for mild tenderness and swelling over the ulnar aspect of her first metacarpophalangeal joint and mildly decreased strength in her pincher grasp. X-ray reveals no fracture. You wonder if there is additional testing that should be done to evaluate this injury.

You move on to a second patient, a 24-year-old man who cut his ring finger knuckle when he punched a wall 2 days ago. Physical examination reveals a small puncture wound over the IV metacarpophalangeal joint with mild swelling, erythema, warmth, and decreased range of motion secondary to pain. X-ray reveals no fracture, but there’s something suspicious about this case.

A third patient is a 37-year-old industrial worker whose finger contacted the stream of a high-powered grease injector. Physical examination...
reveals a small puncture wound over the volar proximal interphalangeal joint of his left long finger, mild tenderness to palpation over the area, and slight decreased range of motion secondary to pain. You wonder if the injury is as benign as it looks.

The hand is a complex and dynamic structure that balances form and function. To many, the hand is a highly versatile tool used to interact with the surrounding world. To others, it is an instrument of expression and beauty. It is this dual purpose that makes the hand arguably one of our most important body parts and, perhaps second only to the face, the most representative of humanity.

Because of the hand’s constant utility, it is no surprise that traumatic hand injuries are encountered on nearly every shift in a busy emergency department (ED). It is estimated that, depending on the setting, 5% to 30% of all injuries presenting to the ED involve the hand (40% of home and work injuries and 15% to 20% of leisure and motor vehicle injuries). Presumably due to higher rates of machine-related jobs as well as higher risk-taking behavior, the male-to-female ratio of hand injuries is 1.7:1, and about 60% of all patients presenting with traumatic hand injuries are between 16 and 32 years of age. While mortality from isolated hand injuries is exceedingly rare, morbidity and loss of productivity is a major concern. Lacerations to the fingers ranks third among reasons for lost workdays in the United States, surpassed only by back and leg strain. Clearly, hand injuries as a whole contribute significantly to unemployment and loss of productive work hours.

Hand trauma presents with such a wide variety of conditions with differing outcomes that a commanding knowledge of hand trauma and anatomy is essential to any practicing emergency clinician. While most patients will require minimal treatment, emergency clinicians must be able to correctly identify conditions that threaten long-term hand function and those that require specialty consultation or surgical repair.

This issue of Emergency Medicine Practice focuses on the diagnosis and treatment of the widely diverse presentation of traumatic hand injuries using the best available evidence from the literature.

Critical Appraisal Of The Literature

A literature search was performed using the following online databases: PubMed, Ovid MEDLINE®, the National Guideline Clearinghouse, and the Cochrane Database of Systematic Reviews. Searches were limited to those published in English, those involving human test subjects, and those involving the widely accepted anatomic definition of the hand; that is, all structures in the upper extremity distal to the carpometacarpal (CMC) joint space. Search terms included but were not limited to the following: hand trauma, hand injuries, finger, fingernail, phalanx, digit, palm, fracture, laceration, crush, dislocation, thumb, amputation, and compartment syndrome. This search yielded many review articles and analytic studies. Of the very few randomized controlled trials found in the literature, most were conducted comparing intraoperative techniques and are, therefore, not applicable to emergency clinicians. Because of the wide variety of traumatic hand injuries, no generalized practice guidelines exist from the 3 major surgical societies involved in surgical hand care (the American Academy of Hand Surgeons [AAHS], the American Academy of Orthopedic Surgeons [AAOS], and the American Society of Plastic Surgeons [ASPS]). Much more data exist in the form of review articles concerning specific conditions in hand trauma.

Thus, the state of the literature concerning management of traumatic hand injuries in the ED is weak, relying mainly on tradition of practice from surgical subspecialties. That said, one practice guideline in the form of a clinical policy statement does exist from the American College of Emergency Physicians (ACEP) regarding specific management of penetrating extremity trauma. Also, the American College of Radiology (ACR) has published one guideline regarding the appropriateness of imaging modalities in hand and wrist trauma. Table 1 summarizes selected portions of these guidelines that are applicable in the ED setting.
always stopped successfully with direct pressure and elevation; however, a proximal tourniquet may be used temporarily for difficult-to-control arterial bleeding. Limb elevation, temporary splinting, ice packs, and authorized analgesics are common methods that may help alleviate patient discomfort. All jewelry, especially rings, should be removed as quickly as possible before tissue swelling makes this difficult.

In the event of a digit or hand amputation injury, prehospital providers should retrieve the limb and initiate cooling measures (described in the “Amputations” section on page 16). Patients may be diverted to facilities designated as special treatment centers in circumstances such as burns, amputations, or snake envenomation. Otherwise, patients should be transported to the nearest ED.

Etiology/Pathophysiology

It is often helpful to categorize hand trauma into a manageable number of categories. Of these, laceration represents the most common injury (62%) followed by fracture (11.4%). Abrasions are likely the most common and underrepresented injury, as most patients do not seek ED treatment.

In order to grasp how hand injuries disrupt function, a clinician must understand the complex mechanics of each part of the hand. While this is a topic best discussed in an anatomy textbook chapter, the ideas can be summarized simply: the hand is a collection of different tissues, and as such, trauma to the hand can be categorized as permutations of severities of damage to these tissues. It is important to consider each type of tissue in the hand when assessing a patient with hand trauma.

Differential Diagnosis

While the differential diagnosis in hand trauma is very broad, the majority of hand injuries are not immediately threatening to life or limb. It is crucial for the emergency clinician to quickly identify injuries that require time-sensitive intervention, such as vascular injuries. (See Table 2, page 4.) Strategies aimed at thorough diagnostic assessment and proper treatment for these etiologies is discussed further in subsequent sections.

Prehospital Care

In most cases of traumatic hand injury, the goal of prehospital care is stabilization of the injured limb. Once the patient has been assessed for trauma to other parts of the body that require more urgent attention, prehospital providers should focus on 3 things: control of hemorrhage, patient comfort, and (if necessary) preservation of amputated digit/hand viability. Active bleeding in the hand is nearly always stopped successfully with direct pressure and elevation; however, a proximal tourniquet may be used temporarily for difficult-to-control arterial bleeding. Limb elevation, temporary splinting, ice packs, and authorized analgesics are common methods that may help alleviate patient discomfort. All jewelry, especially rings, should be removed as quickly as possible before tissue swelling makes this difficult.

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Emergency Department Evaluation

Triage And Initial Stabilization

In general, patients with isolated hand trauma require little to no stabilization. In cases of active bleeding, efforts should be focused on source control with direct pressure and a tourniquet, if necessary. Elevation, immobilization, and ice packs should be utilized if not already in place. In cases of large blood loss or expected intravenous (IV) pain medication requirements, IV access can be considered. All patients expected to require urgent surgical repair should be specified as nothing by mouth (NPO).

History

Because etiology of hand trauma varies greatly, the approach to the patient with traumatic hand injury must first focus on narrowing the differential diagnosis by establishing the timing and mechanism of injury. All patients should be asked about the circumstances surrounding the injury. As with any trauma, patients should be asked if they have injured themselves anywhere else, especially the head.

Table 1. Practice Guidelines For ED Management Of Hand Trauma

<table>
<thead>
<tr>
<th>Organization</th>
<th>Topic</th>
<th>Type of Guidance</th>
<th>Recommendations</th>
</tr>
</thead>
</table>
| American College of Emergency Physicians | Management of penetrating extremity injuries | Evidence-based (Class II) | • Thorough wound exploration, cleansing, and neurovascular examinations  
• Consider antibiotics for very contaminated wounds, bites, and immunosuppressed patients  
• Tetanus prophylaxis as appropriate  
• Low threshold for specialist consultation or outpatient follow-up |
| American College of Radiology | Imaging for patients with hand injury | Expert consensus (Class III) | • X-ray is always recommended in suspected bony injury  
• CT recommended in suspected metacarpal fractures/dislocations not seen on x-ray  
• CT considered for complex intra-articular fractures for surgical planning  
• MRI recommended for gamekeeper’s thumb without fracture  
• US recommended as possible alternative to MRI in gamekeeper’s thumb |

Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging; US, ultrasound.

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or neck, or had a loss of consciousness, since these injuries may require priority attention. In children or in patients who do not remember the event, ask parents, prehospital providers, and available witnesses for details of the injury. Inquiring about hand dominance and occupation—while not crucial to narrowing the differential—can be helpful in determining expected recovery time, risk for functional impairment, and potential temporary job limitations.

Patients should be asked to give a detailed description of the symptoms they have encountered since the injury and their progression over time. Specifically, ask about presence and location of pain, decreased range of motion, functional loss, decreased strength, muscle paralysis, cold/blue fingers, numbness, and tingling. In the event of an amputation injury, ask patients and prehospital providers what happened to the amputated part, how it was cared for, and how much time elapsed before it was cooled. If the skin is broken, history should include bleeding severity and the time since injury, as well as tetanus immunization status. If tetanus immunization has not been given in the past 10 years (5 years for tetanus-prone wounds), patients should be given a tetanus booster. If the 3 childhood vaccinations against tetanus were never completed, or tetanus status is unknown, tetanus immune globulin should be given in the case of dirty or particularly large or tetanus-prone wounds.

Finally, important questions from past medical history include previous injuries or surgeries to the affected limb, current medications (especially anticoagulation medications if uncontrolled hemorrhage is an issue), medication allergies, and whether the patient is immunocompromised. Smoking and diabetes are particularly important, as they slow wound healing.

Table 2. Differential Diagnosis Of Hand Trauma

**Immediately Limb-Threatening**
- Compartment syndrome
- Crush injuries
- High-pressure injections
- Vascular injuries

**Injuries Requiring Rapid ED Assessment/Intervention**
- Dislocations
- Amputations

**Not Immediately Limb-Threatening**
- Nerve injuries
- Fractures
- Lacerations
- Tendon injury
- Ligamentous injury
- Fingertip/fingernail injury

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**Physical Examination**

The physical examination of an isolated hand injury should begin by assessing the general appearance of the hand for gross deformity, active bleeding, and amputations or avulsions as well as how the patient holds the limb at rest. Check skin integrity by examining for any lacerations, swelling/edema, or scars. Palpate for crepitus, particularly in older injuries that may be infected or in mechanisms where air injection is possible. Examine the bones for proper anatomic alignment, tenderness, and active/passive range of motion. (See Figure 1.) Examine for ligamentous injury by placing varus and valgus stress on injured joints, especially the distal interphalangeal (DIP), proximal interphalangeal (PIP), and metacarpophalangeal (MCP) joints. Inspect the digits for rotational variation. If all fingers are not pointing in the same direction when the fist is closed, there is likely a spiral fracture.

Particular care and attention should be placed on the vascular, neurologic, and musculotendinous portions of the examination. Vascular examinations generally rely on the detection of pulses distal to the injury. Because hand trauma is often distal to both the radial and ulnar arteries, it is much more useful to assess warmth, color, and capillary refill. Cold, blue digits with poor (> 2 sec) capillary refill are concerning for arterial injury. Furthermore, lacerations and other penetrating wounds should be carefully explored for vascular injuries. Excessive bleeding can impede a complete exploration of open wounds, and a proximal tourniquet can be helpful in achieving a bloodless field.

Neurologic testing of the hand includes motor and sensory function of 3 nerve distributions: ulnar, radial, and median. (See Figure 2.) Testing should be performed before local anesthetics or...
Diagnostic Studies

Laboratory Evaluation
Isolated hand trauma usually does not require any laboratory testing, and the majority of cases will be managed without drawing any blood. The following laboratory tests are suggested only in very rare circumstances, and no studies exist to suggest they change management or outcome.

Complete Blood Count
A complete blood count (CBC) can be considered in cases of significant blood loss, although this is not specific to hand trauma. Providers should keep in mind that in acute hemorrhage, whole blood is lost and hemoglobin and hematocrit levels are unlikely to reflect degree of blood loss. For cases of significant hemorrhage where a patient is likely to be admitted, a CBC in the ED can serve as a baseline to compare future trends and help aid in the decision for blood transfusion. Because white blood cell counts are often followed in injuries that are likely to become infected, a baseline value at initial presentation is helpful. A platelet count is important for patients with uncontrolled bleeding.

Coagulation Studies
Prothrombin time (PT), partial thromboplastin time (PTT), and international normalized ratio (INR) can

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Action/Innervation</th>
<th>Examination Maneuver</th>
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<tbody>
<tr>
<td>Ulnar motor</td>
<td>Finger abduction/adduction</td>
<td>Finger abduction against resistance</td>
</tr>
<tr>
<td>Ulnar sensory</td>
<td>All dorsal and palmar surfaces medial to ulnar half of digit IV</td>
<td>LT/PP to tip of digit V</td>
</tr>
<tr>
<td>Radial motor</td>
<td>Wrist/finger/thumb extension</td>
<td>Wrist/finger/thumb extension against resistance</td>
</tr>
<tr>
<td>Radial sensory</td>
<td>Dorsum of thumb and hand not innervated by ulnar, dorsum of digits II-IV proximal to PIP joint</td>
<td>LT/PP to dorsal first web space</td>
</tr>
<tr>
<td>Median motor</td>
<td>Thumb opposition; flexion of digits I-III</td>
<td>Maintain ring created by thumb and digits II-V</td>
</tr>
<tr>
<td>Median sensory</td>
<td>Palmar surface not innervated by ulnar nerve, dorsal aspects of digits II-IV distal to PIP joints</td>
<td>LT/PP to tip of digit II</td>
</tr>
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Abbreviations: LT, light touch; PIP, proximal interphalangeal; PP, pin prick.
be considered in patients with difficult-to-control bleeding or bleeding out of proportion to injury. This is particularly true for patients known to be taking warfarin or other anticoagulants. Because hand surgeries are typically low-blood-loss procedures (thanks to intraoperative tourniquet use), baseline or preoperative coagulation studies are not typically indicated.

**Imaging In Hand Trauma**

Imaging is, by far, the most useful diagnostic tool in traumatic hand injury after history and physical examination. More often than not in the ED, the diagnosis and management hinges on the results of an imaging study. Diagnostic imaging should be tailored to confirm or exclude suspected injuries based on the history and physical examination findings. Any attempt at closed reduction in the ED (with the exception of a distal phalanx fracture) requires a set of postreduction films to assess alignment of bony structures.

**Conventional Radiography**

Plain x-ray is the most useful tool for the emergency clinician in assessment of traumatic hand injury. Unlike the Ottawa rules for ankle and knee injuries, no decision rules exist for when to order x-rays of the hand. According to the American Society of Radiology’s published guidelines, any clinically suspected fracture or dislocation in the hand should be evaluated with at least posteroanterior and lateral views, and an oblique view should be strongly considered. Conventional radiography can also be used to evaluate lacerations that are suspected to contain a retained foreign body. The current gold standard for detecting radio-opaque materials (such as glass and metal) is careful scrutiny of multi-view x-rays. Clinicians must keep in mind that some materials (such as plastics and wood) may not show up on x-rays. A 1998 prospective study concluded that mechanisms most likely to have retained glass included motor vehicle collisions and puncture wounds.

**Computed Tomography**

Computed tomography (CT) scanning is rarely used in the evaluation of hand trauma, as it usually does not add significant information to that already obtained by conventional radiography. While no studies have specifically addressed this matter, the following are important exceptions where CT scanning can be considered: complex and/or intra-articular fractures, clinical scenarios highly suspicious of fracture with absence of fracture on x-ray, and at the request of a subspecialist for surgical planning. The emergency clinician should keep in mind that CT scans can provide high resolution of the bony structures of the hand but provide limited information regarding soft tissues such as ligaments, tendons, and muscles.

**Magnetic Resonance Imaging**

Like CT, magnetic resonance imaging (MRI) is only used in specific circumstances in hand trauma. It is important to remember that while MRI is not suited for evaluation of bony structures, it does offer visualization of soft tissues such as ligaments, tendons, muscles, and nerves. Magnetic resonance angiography (MRA) can be used to evaluate vascular structures.

**Ultrasonography**

In the hands of a skilled operator, ultrasound can be used to visualize soft tissue structures. The small structures of the hand are, however, difficult to scan and usually require high-frequency linear probes and an experienced ultrasonographer.

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**Figure 3. Physical Examination Of Hand Tendons**


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should be fully explored to their base to assess the extent of tissue injury and to search for any foreign bodies. Particularly deep lacerations to the palm of the hand should not be explored aggressively, for fear of further damage to deep structures and risk of infection. All lacerations that involve tissue deep to the dermis or those that have continued bleeding should be repaired. A 2002 randomized controlled trial suggests that simple hand lacerations (< 2 cm in length and without associated nerve, tendon, joint, or bony involvement) can be managed conservatively (irrigation, ointment, and dressing) with similar cosmetic and functional outcomes.15

Lacerations should be thoroughly irrigated to remove any debris, and devitalized tissue should be carefully debrided. Classically, sterile saline has been the preferred irrigation solution. However, a 2008 Cochrane systematic review of local wound irrigation demonstrates that irrigation with potable tap water has identical rates of wound infection as sterile saline.16 Solutions of iodine, peroxide, or detergents should be avoided, as they have been shown to be toxic to fibroblasts.17

The ideal time interval between injury and laceration repair has not been fully elucidated in the literature. Several factors must be weighed when considering wound closure: location, depth, degree of contamination, and patient health. A classic emergency medicine prospective study of 204 patients concluded that uncontaminated wounds can be repaired by primary intention up to 12 hours after the time of injury, though it is believed that many can be closed even later. Contaminated wounds can be cleaned, packed, and reexamined for infection 3-5 days post injury. If no signs of infection exist, delayed primary closure is a reasonable option. Infected wounds should be allowed to close by secondary intention.18

The vast majority of hand lacerations are best repaired with nonabsorbable monofilament suture material using a simple interrupted technique. Although there are no current trials supporting timing of suture removal, traditional practice dictates that sutures should be removed in 10-14 days except for those on the palm, which require 14-21 days. There has been a recent push towards using materials that do not require a repeat visit for suture removal, especially in children. A well-designed 2004 randomized controlled trial of 147 children showed no long-term cosmetic or functional difference between the use of plain gut and nylon sutures.19 Absorbable sutures are also useful in repairing deep structures of the hand. Additionally, a 2002 randomized controlled trial of 814 patients concluded that low skin tension on the dorsum of the hand allows it to be repaired successfully with tissue adhesives.20

**Skin Lacerations**

After hemostasis is achieved and appropriate local or regional anesthesia provided, all skin lacerations should be fully explored to their base to assess the extent of tissue injury and to search for any foreign bodies. Particularly deep lacerations to the palm of the hand should not be explored aggressively, for fear of further damage to deep structures and risk of infection. All lacerations that involve tissue deep to the dermis or those that have continued bleeding should be repaired. A 2002 randomized controlled trial suggests that simple hand lacerations (< 2 cm in length and without associated nerve, tendon, joint, or bony involvement) can be managed conservatively (irrigation, ointment, and dressing) with similar cosmetic and functional outcomes.15

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Fingertip Injuries
Fingertip injuries are those that involve any structure distal to the DIP. These injuries are very common, occurring most frequently in young males as a crush/jam injury.\(^{21,22}\)

Distal Phalanx Fractures
Fractures of the distal phalanx can be subcategorized into 3 types: tuft (distal) fractures, shaft fractures, and intra-articular fractures. Though no research exists, reference books generally agree that for the purposes of the emergency clinician, tuft and shaft fractures (see Figure 6) can usually be managed conservatively with repair of soft tissues (as necessary) and splinting in extension for 2-3 weeks. Splinting of the entire finger is unnecessary and may cause stiffness. Severely angulated shaft fractures can be reduced in the ED after digital block and should be splinted for 3 weeks. A hand surgeon should evaluate open fractures or severe crush injuries with large losses of soft tissue. Intra-articular fractures require thorough examination to rule out associated tendon avulsions and should always be evaluated by a hand specialist.\(^{23}\)

Subungual Hematoma/Nail Bed Lacerations
In crush injuries of the finger, nail bed lacerations causing subungual hematomas are common. They are characterized by throbbing pain and purple discoloration under the nail. Two management strategies are commonly used in the ED: removal of the nail, with direct repair of nail bed laceration; and nail trephination with a heated paperclip, a cautery device, or a twirled 18-g needle. A review of the classic literature yields a long-standing debate about which management strategy is superior. The commonly taught “consensus” is that nail bed repair should be considered for subungual hematomas covering greater than 25% to 50% of the nail bed.\(^{25-30}\) However, a 1999 prospective study in children demonstrated no outcome difference at 2 years between operative and trephination groups regardless of presence of underlying fracture or mechanism of injury. Furthermore, the study showed a substantial cost benefit in the nail trephination group.\(^{31}\) Therefore, current literature supports the recommendation that subungual hematomas caused by nail bed lacerations do not require nail removal and direct repair if the nail and its margins are intact.\(^{32}\) If the nail itself is significantly disrupted, the nail bed matrix should be exposed and repaired with fine absorbable sutures. Patients and parents should be warned of potential for infection and permanent nail deformity.

Fingertip Amputations
Management of fingertip amputations must be approached on a case-by-case basis, as there are no current guidelines and little supporting evidence in the literature. Amputations distal to the DIP can usually heal by secondary intention if less than 1 cm in diameter. If there is a small amount of exposed bone, the bone can be trimmed back in the ED with a rongeur until it is underneath the surrounding soft tissue and allowed to heal by secondary intention. Immediate consultation of a hand surgeon is required in cases of wounds larger than 1 cm in diameter, peristently exposed bone, or amputation of the volar pad.\(^{33}\) Additionally, surgeons subclassify fingertip injuries into zones I, II, and III. (See Figure 7.) Zone I injuries are managed conservatively as described above. Zone II injuries may require rongeuring of exposed bone. Zone III injuries generally require distal phalanx amputation and warrant follow-up with a hand specialist.\(^{34}\)

Fractures
Perhaps the most important job of an emergency clinician in hand fractures is proper reduction and

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Figure 5. Ultrasound Visualization Of Nerves And Arteries In The Forearm

![Ultrasound Visualization Of Nerves And Arteries In The Forearm](image)

Ulnar, medial, and radial nerves are shown by the arrow across the bottom of the images. Arrowheads show arteries, A (ulnar), B (medial), and C (radial).

Unstable phalangeal fractures include oblique fractures, malrotated fractures, and angulated fractures. After anesthesia with either a digital block or hematoma block, the emergency clinician should attempt to reduce the fracture with gentle manipulation. Adequate alignment should be confirmed with postreduction x-rays as well as examination of the fingers for evidence of malrotation. Successfully reduced phalangeal fractures should be splinted in extension and referred for outpatient follow-up. Immediate surgical consultation is required for open fractures, unsuccessful reduction, malrotation, and intra-articular fractures involving more than 30% of the joint surface.

Metacarpal II-V Fractures And Boxer’s Fracture
Management of fractures of the II-V metacarpals varies based on the location of the fracture. Metacarpal head and base fractures are relatively rare and require little management in the ED. A volar splint should be applied in a neutral position and the patient referred to a hand surgeon. The emergency clinician can reduce metacarpal shaft fractures after adequate anesthesia with a hematoma block or regional nerve block. Reduction goal is less than 10° of angulation in metacarpals II and III, less than 20° of angulation in metacarpals IV and V, less than 3 mm of digit length loss, and no rotational deformity. These stable fractures are managed by “buddy-taping” the affected finger to the adjacent finger to promote early mobilization and reduce stiffness. (See Figure 9, page 10.)

Proximal And Middle Phalanx Fractures
Unlike distal phalanx fractures, proximal and middle phalanx fractures require precise alignment. That said, the majority of phalangeal fractures do not require reduction, as they are stable and nondisplaced (usually transverse). These stable fractures are managed by “buddy-taping” the affected finger to the adjacent finger to promote early mobilization and reduce stiffness. (See Figure 9, page 10.)

Figure 6. Radiograph Demonstrating Phalanx Fractures
Left arrow notes a tuft fracture of digit IV. Right arrow notes a shaft fracture of the distal phalanx of digit III.
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Figure 7. Zones Of Fingertip Amputation
Zone I II III
Zone I II III
Metacarpal neck fractures deserve special mention as they are among the most common fractures of the hand. Nondisplaced, nonangulated fractures should be treated with a gutter splint that immobilizes the CMC and MCP joints for 3-4 weeks, with surgical clinic follow-up. Unstable fractures of the II and III metacarpals generally require immediate consultation by a hand surgeon for surgical correction. Unstable fractures in the IV and/or V metacarpals, also known as a boxer’s fracture, can be reduced in the ED after adequate anesthesia. In the author’s experience, a forearm ulnar nerve block in conjunction with a hematoma block using 1% lidocaine without epinephrine provides excellent results. Reduction is achieved by traction decompression followed by the “90-90 method.” (See Figure 10.) The MCP, PIP, and DIP joints are flexed at 90° and volar-ward pressure is applied to the dorsum of the metacarpal shaft. An ulnar gutter splint should be applied with prompt clinic follow-up within 1 week.

Much controversy exists in the literature regarding the goal of boxer’s fracture reduction. Classic literature supports acceptable angulation between 20° and 70°. More-recent studies are incongruent. A 1999 cadaveric study concluded that angulation greater than 30° resulted in measurable functional impairment. Two more recent prospective studies, however, found good outcomes with 1 week of soft wrap followed by immediate buddy-wrapping of angulations up to 70° to 75°. The emergency clinician should not forget that boxer’s fractures are often a consequence of violent and intentional behavior and patients are at risk for recurrent injury. In addition, boxer’s fracture patients have higher rates of anxiety, borderline personality disorder, and antisocial personality disorder. As such, patients with boxer’s fractures should receive in their ED evaluation psychiatric questioning as well as prevention strategies.

**Thumb Metacarpal Fractures: Bennett And Rolando Fractures**

Fractures of the first metacarpal are less common than those of the remaining metacarpals. They can be subdivided into extra-articular and intra-articular fractures. Extra-articular fractures follow the same conservative management principles as other metacarpal fractures, namely, closed reduction (Bennett fracture only), surgical clinic follow-up.

Intra-articular fractures of the first metacarpal involve the CMC joint and generally occur due to an axial injury to a partially flexed metacarpal. A Bennett fracture is an intra-articular fracture and dislocation; a Rolando fracture is a comminuted intra-articular fracture. (See Figure 11.) While debate exists regarding the specific type of surgical correction each fracture requires, the available literature supports that emergency management should consist of closed reduction (Bennett fracture only), followed by buddy-wrapping.

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**Figure 8. The “Intrinsic Plus” Splinting Position**

[Image of a hand in a splinting position]

- Used with permission of Aaron Andrade, MD.

**Figure 9. “Buddy-Taping” An Injured Finger**

[Image of a hand with a buddy tape]

- Used with permission of Aaron Andrade, MD.
Tendon Injuries

Injuries to hand tendons most often occur due to laceration, crush, or forceful hyperextension/hyperflexion injuries. Regardless of the mechanism, tendon injuries share the following common management strategies: (1) radiographs should be obtained to rule out associated fractures and avulsions, (2) surgical consultants should evaluate open tendon lacerations immediately for surgical repair, and (3) closed tendon injuries require splinting and surgical follow-up. Clinicians in the ED should remember that tendons often run close to peripheral nerves and vascular structures, so the presence of a tendon injury should raise suspicion for possible neurovascular injury.53

Mallet Finger

A mallet finger is a very common injury of the extensor tendon insertion into the distal phalanx, usually caused by forced flexion of the DIP joint. It is so named because the flexed DIP cannot be extended and looks like a mallet. The injury can sometimes be associated with an avulsion fracture of the dorsal base of the distal phalanx. The classic strategy for treating closed mallet finger injuries with less than one-third of the joint surface disrupted is continuous splinting of the DIP joint in full extension to hyperextension for at least 6 weeks.54,55 Strict compliance is necessary, which can prove difficult for patients due to hygiene and comfort issues. Because of this, many different types of splints are available for commercial use.56,57 (See Figure 12.) Note that the PIP is not splinted. The few randomized trials comparing splints demonstrate equal efficacy as long as patients follow strict compliance.58-60 One study in cadavers has shown that PIP motion does not affect structural integrity of the DIP tendon, and therefore splinting of the entire finger is not recommended, as it may cause unnecessary stiffness.61 Furthermore, no difference in outcome has been measured between early and delayed splinting of mallet finger.62

In spite of the high success rates of conservative management, some debate remains over which cases of mallet finger require surgical management. Classically, all open injuries and those with greater than

Figure 10. The “90-90” Method

Used with permission of Aaron Andrade, MD.

Figure 11. Radiographs Of A Bennett Fracture (Left) And A Rolando Fracture (Right)


Figure 12. Splinting The DIP In Full To Hyperextension

Used with permission, Aaron Andrade, MD.
Clinical Pathway For Management Of Hand Injuries (Continued on page 13)

### METACARPAL FRACTURES

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMC fracture-dislocations or open fractures</td>
<td>Emergent/urgent surgical consult (Class I-II)</td>
</tr>
</tbody>
</table>
| Displaced intra-articular, unstable, irreducible, or comminuted fractures | Splint and refer (Class III)  
Surgical consult from ED to discuss timing of repair (Class III) |
| Reducible/stable MC II-V fractures | Gutter splint and refer (Class II) |
| Thumb MC fractures (Bennett, Rolando, etc) | Thumb spica; early referral if operative repair required (Class II) |

### FINGER FRACTURES

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nondisplaced, stable fractures</td>
<td>Buddy-tape splint and refer (Class II)</td>
</tr>
</tbody>
</table>
| Displaced intra-articular, unstable, or angulated fractures | Splint and refer (Class III)  
Surgical consult from ED to discuss timing of repair (Class III) |

### OPEN FRACTURES

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximal/middle phalanx</td>
<td>Emergent/urgent surgical consult (Class II-III)</td>
</tr>
<tr>
<td>Distal phalanx</td>
<td>Irrigate/debride/repair in ED (Class III)</td>
</tr>
</tbody>
</table>

### DISLOCATIONS/LIGAMENT INJURIES

<table>
<thead>
<tr>
<th>Dislocation Type</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced IP or MP dislocations, collateral ligament, or volar plate injury</td>
<td>Splint and refer (Class II-III)</td>
</tr>
<tr>
<td>Complex or irreducible dislocations</td>
<td>Urgent surgical consult (Class III)</td>
</tr>
<tr>
<td>Thumb UCL (skier’s thumb) or RCL injury</td>
<td>Thumb spica and refer (Class II)</td>
</tr>
</tbody>
</table>

Abbreviations: CMC, carpometacarpal; ED, emergency department; IP, interphalangeal; MC, metacarpal; MP, metacarpophalangeal; RCL, radial collateral ligament; UCL, ulnar collateral ligament.
Clinical Pathway For Management Of Hand Injuries (Continued from page 12)

TENDON INJURIES

FLEXOR TENDONS

Closed FDP avulsion (jersey finger)
• Splint; early referral for operative repair (Class II-III)

Open flexor tendon laceration
• Surgical consult for timing of repair (Class III)
• Close skin and splint, if referring (Class II)

EXTENSOR TENDONS

Closed injury (mallet, PIP, or extensor digitorum injury, acute boutonniere)
• Splint appropriately and refer (Class II)

Open uncontaminated laceration
• Consider repair of zone II-IV lacerations in ED (Class III)
• Close skin and splint, if referring early (Class II)

High-pressure injection injury
• X-ray (Class III)
• Avoid digital blocks (Class III)
• Tetanus prophylaxis (Class I-II)
• IV antibiotics (Class III)
• Emergent/urgent surgical consult (Class II)

Abbreviations: ED, emergency department; FDP, flexor digitorum profundus; IV, intravenous; PIP, proximal interphalangeal joint.

Class Of Evidence Definitions

Each action in the clinical pathways section of Emergency Medicine Practice receives a score based on the following definitions.

Class I
- Always acceptable, safe
- Definitely useful
- Proven in both efficacy and effectiveness

Level of Evidence:
- One or more large prospective studies are present (with rare exceptions)
- High-quality meta-analyses
- Study results consistently positive and compelling

Class II
- Safe, acceptable
- Probably useful
- Considered optional or alternative treatments

Level of Evidence:
- Generally higher levels of evidence
- Non-randomized or retrospектив studies: historic, cohort, or case control studies
- Less robust RCTs
- Results consistently positive

Class III
- May be acceptable
- Possibly useful
- Considered optional or alternative treatments

Level of Evidence:
- Generally lower or intermediate levels of evidence
- Case series, animal studies, consensus panels
- Occasionally positive results

Indeterminate
- Continuing area of research
- No recommendations until further research

Level of Evidence:
- Evidence not available
- Higher studies in progress
- Results inconsistent, contradictory
- Results not compelling


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one-third of joint surface involvement should receive immediate surgical consultation. More-recent trials demonstrate no outcome difference between splinting and surgical correction as far as 2 years post-injury.\textsuperscript{63-65} Some hand surgeon experts believe that all closed mallet fingers should be initially splinted and that surgical correction should be saved for those that fail conservative management.\textsuperscript{66} A 2008 Cochrane meta-analysis demonstrated no difference in surgical and conservative management as well as no difference between different types of splints.\textsuperscript{67}

**Jersey Finger**

Jersey finger is the disruption of the FDP tendon insertion to the volar surface of the distal phalanx during a resisted, forceful extension. It derives its name because it often occurs during sporting events when one player tugs at another’s jersey. Patients will present with inability to flex the DIP joint despite full passive range of motion. (See Figure 13.) Like mallet finger, jersey finger can be an isolated tendon injury or it can be associated with a bony avulsion. Unlike mallet finger, all jersey finger injuries require prompt surgical correction, so immediate specialist consultation is the rule.\textsuperscript{68,69} Very little evidence exists in the literature regarding this rare injury. Nonetheless, ED interventions should include pain control and immobilization in a neutral position to prevent further tendon retraction. While every suspected jersey finger requires x-rays, one case report describes using ultrasound as a useful tool in confirming FDP tendon injury.\textsuperscript{70}

**Fight Bite**

Fight bite, or clenched fist injury, occurs when a closed fist strikes a tooth, causing a laceration at the MCP joint. As the fist is relaxed and the fingers extended, oral bacteria that entered the extensor tendon sheath are tracked back along the tendon. In spite of a fight bite’s minor external appearance, a retrospective study of 194 surgical explorations of fight bite injuries demonstrated that nearly 75% of these injuries had damage to underlying tendon, joint, or bone.\textsuperscript{71} Patients often will hide the true cause of this injury (as in the second clinical vignette patient), so the clinician must consider any MCP laceration to be a fight bite until proven otherwise. The available literature supports that fight bites require aggressive early management, including radiographs to evaluate for foreign bodies and fractures, elevation, immobilization, early surgical consultation for exploration and washout, and admission to the hospital for IV antibiotics.\textsuperscript{72,73} Known infectious complications in untreated patients include osteomyelitis, tenosynovitis, and septic arthritis. Many studies demonstrate a wide range of microbes infecting closed-fist injuries, classically *Eikenella*, but most commonly polymicrobial mouth and skin flora.\textsuperscript{74-79} The chosen antibiotic regimen must cover *Staphylococcus*, *Streptococcus*, and anaerobic species – for example, ampicillin/sulbactam, cefoxitin, or a carbapenem.

**Boutonniere Deformity**

Though more commonly thought of as a complication of rheumatoid arthritis, boutonniere deformity can occur as a result of acute injury to the central slip—the anchor of the extensor tendon to the dorsal middle phalanx. This results in disruption of normal extensor/flexor balance. While large deformities are visibly obvious (see Figure 14), subtle deformity is detected by testing active PIP extension strength or by detecting PIP extension lag during forced MCP flexion, as discussed in a case series of 67 patients by Smith et al and a cadaveric study by Rubin et al.\textsuperscript{80,81} Very little literature exists about this rare injury. A case series of 3 patients by Cardon et al\textsuperscript{82} and a retrospective study of 8 patients by Imatami et al\textsuperscript{83} provide weak evidence supporting general treatment principles. Open injuries and those associated with fractures require immediate hand specialist consultation for possible surgical correction. Closed injuries can be conservatively managed with splinting of the PIP joint in extension for 4 weeks and outpatient hand specialist follow-up.

**Ligamentous Injury**

Ligamentous injuries vary from simple sprains to complete rupture, causing joint subluxation or dislocation. The emergency clinician should test for joint stability, order radiographs to rule out fractures, and reduce any subluxations or dislocations after appropriate regional anesthesia. Simple sprains and strains should be managed conservatively with oral pain medications, ice, rest, elevation, and soft wraps as necessary.\textsuperscript{9}

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**Figure 13. Jersey Finger In The Right Digit IV**

Notice that in minimal flexion (A) and full flexion (B), the DIP of the fourth digit remains extended. In contrast, mallet fingers are unable to be fully extended.

Used with permission, Aaron Andrade, MD.
**Subluxation/Dislocation**
Disruption of the IP joints or the MCP joints generally warrants closed reduction in the ED, splinting in slight flexion for 2-3 weeks, and outpatient hand specialist follow-up. Plain films are necessary to assess presence of associated avulsion fractures and to confirm postreduction alignment. While a lack of literature exists on ED management, traditional practice suggests that avulsion fractures that involve more than one-third of the joint surface require immediate hand surgeon consultation and operative management. Closed reduction of IP joints and MCP joints are fairly similar and require gentle traction following appropriate regional nerve block. If a dislocation is irreducible, this may be due to entrapment of a bony fragment, a tendon, or the volar plate in the joint space. Such cases require immediate hand surgeon consultation.9,84

**Gamekeeper’s Thumb And Skier’s Thumb**
Ligament tears and ruptures can occur anywhere in the hand, but the most common ligament to be injured is the ulnar collateral ligament (UCL) of the thumb, as seen in the patient in the first clinical vignette. Traditionally, this injury was given the name “gamekeeper’s thumb” because it most commonly affected English gamekeepers from the repetitive motion of breaking rabbit necks. Today, this injury is seen more acutely after skiing accidents and as such has been named “skier’s thumb.” The injury itself occurs due to a forceful radial deviation of the thumb, causing pain and swelling on the ulnar aspect of the first MCP joint.85

The examination of joint laxity is often difficult due to pain, usually requiring median and radial nerve blocks. The emergency clinician should place valgus stress (radial deviation) on the first MCP joint while the thumb is in full extension and in 30° of flexion. (See Figure 15.) Thumb deviation greater than 35° or 15° further than the unaffected thumb is indicative of a complete ligament tear.86 Complete tears have a high incidence of associated Stener lesion (the adductor pollicis aponeurosis becomes stuck between ruptured ends of the UCL), resulting in poor healing. This requires prompt hand specialist follow-up so that surgical repair may occur within 3 weeks of injury.87 Partial tears usually heal well with conservative management and should be immobilized in a thumb spica cast for 4 weeks, with outpatient follow-up.

In cases where it is difficult to distinguish partial versus complete UCL tears, additional imaging is very useful. In a 1999 double-blind prospective study of 34 patients using surgical findings as the gold standard, MRI was shown to have a 96% sensitivity and 95% specificity in detecting complete tears.88 Because repair is not required for 3 weeks, MRI may be scheduled as an outpatient and should not delay ED disposition.

More recent literature assesses the utility of ultrasound in these cases, showing a sensitivity of 83% and specificity of 75% compared to surgical and cadaveric gold standards.89,90 A 1997 retrospective study concluded that the most common ultrasound error is misdiagnosing a complete tear as a partial tear, while the opposite is rarely true.91 Therefore, partial tears diagnosed on ultrasound should be confirmed with an MRI as an outpatient before operative management is entirely abandoned. While ultrasound is dependent on technical ability, it should be considered as a useful alternative or adjunct to MRI.

**Vascular Injuries**
Significant morbidity from vascular injuries of the hand is actually quite rare due to the dual supply from the radial and ulnar arteries. Initial ED

![Figure 14. Boutonniere Deformity](image)

**Figure 14. Boutonniere Deformity**
- Central slip disruption
- Volar migration of the lateral bands

![Figure 15. Valgus Stress Testing Of The First MCP Joint](image)

**Figure 15. Valgus Stress Testing Of The First MCP Joint**

Ulnar deviation by greater than 35° or 15° more than the unaffected side is diagnostic of a complete UCL rupture.

management should focus on control of active hemorrhage with direct pressure and application of a tourniquet. Although evidence in the literature is lacking, traditional practice recommends against direct clamping of arteries in the ED, due to a high risk of irreversible damage to vasculature, tendons, and nerves. Ligation, suturing, and injection with epinephrine are also tempting strategies that should be avoided. Rather, any suspected or confirmed vascular injury causing distal ischemia requires immediate surgical consultation. The traditional maneuver for testing ulnar and radial arterial flow to the hand is called the Allen’s test.

Nerve Injuries
The management strategy of hand nerve injuries in the ED is determined by whether the injury is closed or open. All nerve injuries should be splinted to prevent further nerve damage. Closed injuries are more likely to be due to neuropraxia or axonotmesis—juries to the axon without disruption of the endoneurium required for regeneration. They require outpatient hand surgeon follow-up for repeat physical examinations. Open injuries, in contrast, are much more likely to be due to fully severed nerves. Without an intact endoneurium, nerve regeneration is not possible. Therefore, all open injuries associated with significant sensory or motor deficits require immediate hand surgeon consultation for possible nerve repair.

Special Circumstances

High-Pressure Injection Injuries
High-pressure injection injuries are very uncommon, so strong evidence regarding their management is lacking. They tend to occur in the nondominant hands of industrial workers. While paints and oils are the most common materials involved, the literature is filled with case reports of incidents involving water, air, solvents, and even molten metal and cement. Superficial signs of injury can be deceptively minimal, as in the third clinical vignette patient, and even imaging may misrepresent the full extent of tissue damage. (See Figure 16.) Regardless of the material injected, these injuries are associated with a high risk of infection and amputation, particularly when vascular compromise is present. Long-term functional impairment is common and even associated malignancy has been reported.

While certain cases can be successfully managed conservatively (such as water injections only involving the fingertips), every case of high-pressure injection requires immediate hand surgeon consultation for probable surgical debridement. Other management in the ED includes splinting, elevation, pain control, and broad-spectrum antibiotics. Regional nerve blocks are contraindicated because they impair serial examinations for vascular compromise. While rare, a case report suggests that patients presenting with acute chest pain, shortness of breath, or cardiovascular collapse following a high-pressure air injection should be evaluated for pneumomediastinum, pneumothorax, and gas embolism.

Amputations
Every case of finger and hand amputation requires immediate consultation by a hand surgeon, with the exception of very distal tip amputations as discussed in the section “Fingertip Amputations” on page 8. Replantation is nearly always considered, and surgical repair is required even if replantation is contra-indicated. Success rates depend on ischemia time, degree of tissue damage, and mechanism of injury. Sharp lacerations are more likely to yield successful replantation than crush injuries (62% vs 50%). In one study, fingertip amputations (the most common amputation injury of the hand) had a 78% replantation success rate.

Figure 16. Tissue Involvement Of High-Pressure Injection Of Paint

Radiograph (left) and intraoperative photograph (right) showing the extent of tissue involvement in a high-pressure injection of paint. Used with permission of New Zealand Journal of Medicine.
Risk Management Pitfalls For Hand Injuries

1. “I couldn’t see all the way to the base of the laceration, but I’m sure there is no glass inside.” Lacerations caused by glass and other brittle materials are at high risk for retained foreign body. Inability to explore the laceration completely to its base or a patient having the sensation of foreign body should prompt multiple-view radiographs prior to laceration repair.

2. “A patient with a sutured laceration came back for a wound check with signs of infection, so I prescribed antibiotics and asked the patient to return in a few days for suture removal.” While antibiotic treatment is reasonable in this case, infected lacerations or those that present for repair later than 12-24 hours after injury should be allowed to heal by secondary intention. In this case, immediate suture removal and irrigation/debridement of the wound is essential.

3. “I didn’t see a fracture on the x-ray.” Radiographs are not 100% sensitive for detection of fracture. To maximize the sensitivity, emergency clinicians should ensure that multiple views are obtained, including posteroanterior, lateral, and oblique. In cases where fracture is highly suspected, the safest practice is to splint the affected extremity and refer for outpatient hand specialist follow-up. In cases where formal radiology reads are pending, patients should be informed that they may be called back with additional findings.

4. “I saw the bleeding artery in the laceration, so I clamped it.” Lacerated hand vessels, even when easily visible, should never be clamped by an emergency clinician. The risk of causing further vascular damage, tendon damage, and nerve damage is extremely high. Emergency department management should focus on hemorrhage control with direct pressure and proximal tourniquet application. Direct repair of vasculature is best left to a surgical specialist.

5. “The child with the severely crushed hand was having so much pain and tingling, I had to perform a regional nerve block.” While rare, compartment syndrome of the hand does exist. The emergency clinician must be able to recognize high-risk mechanisms such as crush injuries and early physical examination findings such as increasing pain and paresthesias. Regional nerve blocks are contraindicated in suspected compartment syndrome as they prevent meaningful repeat physical examinations.

6. “The pressurized injection injury looked like a very small red dot on the finger, so I sent the patient home with pain medications” High-pressure injection injuries can look deceptively minor on physical examination. All cases require x-rays to better visualize the extent of injury. Due to the high risk of amputation and permanent functional impairment, every case should be admitted for IV antibiotics and likely surgical debridement.

7. “I cleared the patient as fit for incarceration because all he had was a bite mark on his knuckle.” Fight bites may look minor on physical examination, but they carry a high risk of soft tissue infection and loss of function. All cases require antibiotics and surgical consult for possible debridement and washout. Patients will often hide the true mechanism of this injury, so lacerations to the MCP should be considered a fight bite until proven otherwise.

8. “I wanted to be safe, so I splinted the entire mallet finger from the DIP to the MCP.” Mallet fingers have been shown to heal with good functional outcomes after DIP splinting in extension for 6 weeks. Immobilization of more proximal joints is unnecessary and can lead to undue joint stiffness.

9. “I couldn’t successfully reduce the dislocation, so I splinted it and referred the patient for outpatient follow-up.” Any dislocation or fracture that fails closed reduction warrants immediate surgical consultation. In particular, irreducible dislocations often occur due to intra-articular bone fragments or an entrapped volar plate. While awaiting surgical consultation, management should focus on pain control and splinting in a comfortable position.

10. “I placed the amputated finger directly in a bucket of ice water to increase viability.” Direct contact with ice and excessive water can cause irreversible damage to amputated limbs. The proper technique for cooling is to wrap the amputated part in saline-moistened gauze and place in a sealed plastic bag. This bag is placed into an insulated container with a sealed bag of ice. Properly cooled parts can remain viable up to 12-24 hours, depending on the tissues involved.
Compartment Syndrome

While rare, compartment syndrome of the hand does occur and results in devastating tissue damage if left untreated. The hand has 10 separate compartments, making detection based on a pattern of examination findings difficult. Increasing pain and paresthesias are the earliest signs to emerge, followed by paresis and pallor, and finally pulselessness (unless vessels are directly injured). Emergency clinicians should be suspicious of compartment syndrome in crush injuries, circumferential burns with eschar formation, pain out of proportion to mechanism, rapidly increasing pain despite treatment, palpably tense tissues, and evidence of nerve or vascular injuries. Measuring compartment pressures, while possible, is difficult due to complex compartmental anatomy and is reasonable to leave to a hand surgeon. Immediate surgical consultation is required.

While awaiting definitive treatment, ED management should focus on reducing compartment pressure by means of limb elevation and removal or loosening of bandages and casts. In the case of circumferential full-thickness burns, escharotomy should be attempted if surgical management will be delayed. Finally, regional nerve blocks are contraindicated in suspected compartment syndrome as they eliminate the ability to perform serial physical examinations.

Controversies/Cutting Edge

NSAIDs And Impaired Wound Healing

Patients are commonly prescribed nonsteroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen, for pain relief for skin and soft-tissue wounds.
There is little evidence supporting the theory that short-term use of NSAIDs interferes with wound healing. Recent literature, however, is split on whether long-term NSAID use may inhibit wound healing. Four animal models conducted between 1993 and 2007 concluded that NSAID use inhibited wound contracture, epithelialization, proliferation of fibroblasts, and angiogenesis.\textsuperscript{118-121} On the contrary, a 2007 randomized controlled trial of 122 patients showed that topical ibuprofen does not inhibit wound healing of chronic venous ulcers.\textsuperscript{122} For the ED patient population (acute wounds in humans), it is difficult to draw a meaningful conclusion from this literature. A safe practice would be for an emergency clinician to use NSAIDs in conjunction with other analgesic medications for short periods of time and to encourage long-term, high-dose NSAID users to reduce their dose of NSAID until their wound has healed properly.

**Epinephrine In Digital Nerve Blocks**

Avoiding the use of epinephrine in digital nerve blocks for fear of distal ischemia is a concept that is deeply ingrained in practicing emergency clinicians. Benefits of epinephrine include less bleeding, less systemic absorption of anesthetic, and longer and more complete anesthesia with less medication. In the past 10 years, several studies have shown that the true incidence of epinephrine-induced ischemia is extremely low.\textsuperscript{123,124} Only 17 cases have ever been reported in worldwide literature.\textsuperscript{125} Furthermore, phentolamine, the injectable antidote, is readily available in hospitals. Based on this recent data, epinephrine use is likely very safe for use in digital nerve blocks. It should still be avoided in injuries with suspected vascular damage and in patients with known digital vasospasm (such as Raynaud’s) or peripheral vascular disease.\textsuperscript{126-128} Despite this data, this author will continue to avoid the use of epinephrine in hand anesthesia because the benefits of longer-lasting anesthesia and less bleeding can be achieved by the use of bupivacaine and a proximal tourniquet.

**Disposition**

Most patients with isolated hand trauma do not require admission to the hospital. Exceptions, of course, include cases that need ongoing IV antibiotics, immediate surgical repair or exploration (fight bites), or therapeutic amputation as determined by consultants. Patients with minor soft-tissue injuries should follow up in the ED or with a primary care provider for suture removal (if necessary) and repeat physical examination. Patients with more extensive tissue injuries that do not require admission warrant outpatient follow-up with a hand surgeon.

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**Summary**

The hand is one of the most precious parts of the human body, and loss of its normal function has significant and long-lasting impact on productivity, ability to earn a livelihood, quality of life, and self-esteem. The patterns of traumatic hand injury are varied and complex, and as such, management must be tailored to each individual case. A sound knowledge of hand anatomy and high-risk conditions is essential to the emergency clinician’s practice. Respect for the hand’s importance should generally sway practitioners to a more conservative management approach. When in doubt, specialty consultation, immobilization, and prompt follow-up are safe strategies that ensure optimal patient outcomes.

**Case Conclusions**

Based on your physical examination findings, you suspected that your 34-year-old female skier with thumb MCP joint laxity had a UCL tear, or skier’s thumb. Knowing that the feasibility of conservative management hinges on whether the tear is complete or partial, you decided to perform your examination again after radial and median nerve blocks. Under valgus stressing in full extension and 30° of flexion, the affected and unaffected thumbs deflected to 20° and 10° of angulation, respectively. Still suspicious of a complete UCL tear, you decided to pursue further imaging. Because MRI was not available until Monday morning, you performed an ultrasound, which revealed significant disruption of the UCL. Remembering that complete UCL ruptures can be surgically repaired with equal outcomes up to 3 weeks postinjury, you placed the patient in a thumb spica cast and arranged a follow-up appointment with the local hand specialist in 2 weeks.

Returning to your second patient, the 24-year-old male with a dorsal MCP laceration supposedly from punching a wall, you astutely questioned the patient about the possibility of the injury being from a punch to a human mouth. After advising the patient on the importance of the matter, the patient disclosed that the injury was, in fact, from a fistfight. You started IV antibiotics, consulted the hand specialist, and admitted the patient for likely surgical debridement.

You made your way back to your final patient, the 37-year-old male with a high-pressure grease injection to his finger. Despite minor findings on physical examination, you remembered that these injuries are associated with high rates of infection, limb ischemia, and need for amputation. You ordered x-rays, started broad-spectrum IV antibiotics, and called the hand specialist to come in immediately for surgical evaluation.
Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study, such as the type of study and the number of patients in the study, will be included in bold type following the reference, where available. In addition, the most informative references cited in this paper, as determined by the authors, will be noted by an asterisk (*) next to the number of the reference.


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CME Questions

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1. What is the most common type of traumatic hand injury?  
   a. Fractures  
   b. Lacerations  
   c. Crushes  
   d. Burns

2. Which of the following physical examination findings is most consistent with a limb-threatening injury?  
   a. Fracture  
   b. Tendon injury  
   c. Ligament injury  
   d. Crush injury

3. Which nerve distribution(s) must be blocked to achieve complete anesthesia of the thumb?  
   a. Radial only  
   b. Median only  
   c. Radial and median  
   d. Radial, median, and ulnar

4. Which of the following combination of physical examination findings tests the function of the ulnar nerve?  
   a. Pinprick sensation to the middle finger tip/thumb and middle finger opposition  
   b. Pinprick sensation to the index finger tip/wrist extension  
   c. Pinprick sensation to the little finger tip/little finger extension  
   d. Pinprick sensation to the medial distal aspect of the ring finger/index finger abdution

5. How much time should elapse before sutures may be removed from the dorsal finger and the palm, respectively?  
   a. 7-10 days and 14-21 days  
   b. 3-5 days and 10-14 days  
   c. 3-5 days and 14-21 days  
   d. 10-14 days and 14-21 days

6. According to the literature, what finding deems nail removal and direct nail bed laceration repair a superior intervention to nail trephination in the setting of subungual hematoma?  
   a. Tuft fracture  
   b. Hematoma covering greater than 50% of the nail surface  
   c. Disruption of the nail or its margins  
   d. Finger pad amputation

7. What is the minimum amount of joint laxity required to clinically confirm the diagnosis of complete ulnar collateral ligament tear of the thumb?  
   a. 15° or 5° greater than the unaffected side  
   b. 20° or 10° greater than the unaffected side  
   c. 30° or 10° greater than the unaffected side  
   d. 35° or 15° greater than the unaffected side

8. Which of the following represents the most complete and appropriate ED management of a brisk arterial hemorrhage of the hand?  
   a. Direct pressure, elevation, and proximal tourniquet placement  
   b. Localization and direct clamping of the artery  
   c. Localization and tying off of the artery with absorbable suture  
   d. Injection of the area with high-dose (1:1000) epinephrine
9. What structure must be intact for axons to regenerate in nerve injuries?
   a. Adjacent venous structures
   b. Surrounding muscle tissue
   c. Schwann cells
   d. Endoneurium

10. Nonsurgical management can be considered in the high-pressure injection of which of the following materials?
   a. Water
   b. Air
   c. Gasoline
   d. Paint

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