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Evidence-Based Management Of Acute Hand Injuries In The Emergency Department

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Abstract

Although injuries of the hand are infrequently life-threatening, they are common in the emergency department and are associated with significant patient morbidity and medicolegal risk for physicians. Care of patients with acute hand injury begins with a focused history and physical examination. In most clinical scenarios, a diagnosis is achieved clinically or with plain radiographs. While most patients require straightforward treatment, the emergency clinician must rapidly identify limb-threatening injuries, obtain critical clinical information, navigate diagnostic uncertainty, and facilitate specialist consultation, when required. This review discusses the clinical evaluation and management of high-morbidity hand injuries in the context of the current evidence.

CME Objectives

Upon completion of this article, you should be able to:

1. Perform a focused and complete history and physical examination pertinent to acute hand injuries.
2. Discuss the management strategies for a broad range of acute hand injuries.
3. Identify limb-threatening hand injuries that require emergent hand surgery consultation.

Prior to beginning this activity, see "Physician CME Information" on the back page.

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Case Presentations

It's a busy afternoon in the ED. A 32-year-old man with a laceration of his left palm is placed in your next open bed. The injury occurred 1 hour prior to arrival as he was using a flat-head screwdriver to open a can of paint. He complains of pain and swelling at the wound site and inability to flex his fifth digit. The patient is right-handed, works in construction, has a history of hypertension, and his last tetanus shot was 12 years ago. There is a 3-cm laceration of the palmar surface of the base of the fifth digit. He is unable to flex the fifth digit at the PIP joint or DIP joint. You order 3-view hand radiographs, update his Tdap vaccine, and prepare for local anesthesia, irrigation, and wound exploration. You suspect the patient has a flexor tendon injury.

A second patient is brought in by EMS after 911 was called to a local bar. The patient exhibits confusion, dysarthria, ataxia, and nystagmus. The paramedic states, "He drank way too much." The patient's right hand is swollen over the fourth and fifth MCP joints and there is a 5-mm puncture wound over the fourth MCP joint. The stumbling patient states, in slurred speech, "I'm fine. I punched a wall and I'm outta here!" Hospital security is contacted.

Your third patient is a 55-year-old woman, who is brought in by EMS following a motor vehicle crash. She is on a spine board with cervical spine immobilization. The paramedic tells you she was the restrained driver in a head-on motor vehicle crash at high speed, and the airbag deployed. She is confused, with a GCS score of 14. There is a large abrasion over her left maxilla. During your secondary survey, you notice swelling over the MCP joint of her left thumb. You are most concerned about an intracranial injury and want to expedite CT imaging, but you jot down a note to reassess her left hand.

Introduction

The anatomical complexity of the hand mirrors its diverse functional capabilities. A significant subset of patients presenting to the emergency department (ED) with acute hand trauma are at risk for poor compliance, delayed presentation, and substance abuse.[1,2] The complexity of the hand, the psychosocial characteristics of the prototypical hand trauma patient, and the potential for missed injury in multisystem trauma create a challenging environment for the emergency clinician in evaluating hand injuries. Understanding the limitations of imaging studies (eg, the presence of false-negative radiographs in suspected fracture) and acknowledgement of several critical diagnoses made purely on clinical criteria (eg, gamekeeper's thumb) underscores the significance of physical examination skills.

The National Electronic Injury Surveillance System (NEISS) data on acute hand injury show that hand injuries are more likely to occur among males (male-to-female ratio of occurrence, 1.7:1), and are more common among individuals aged ≥ 18 years.[3,4,5]

The United States Bureau of Labor Statistics reports that hand injuries are the second most common injury resulting in days away from work.[6]

Decreasing reimbursement rates, changing perceptions of medicolegal risk, and requirements for the Subspecialty Certificate in Surgery of the Hand has resulted in variable hand surgeon availability in many EDs.[7] Although rarely life-threatening, hand injuries are associated with significant patient morbidity and physician medicolegal risk.[8] A 2010 retrospective review by Brown et al of 11,529 closed malpractice claims from 1985 to 2007 reported that open finger injuries were in the top 10 most common diagnoses resulting in medical malpractice litigation.[9]

While most hand injuries require straightforward treatment, the emergency clinician must rapidly identify limb-threatening injuries, obtain specific critical clinical information, navigate diagnostic uncertainty, and facilitate rapid intervention, transfer, and/or specialist consultation. This issue of *Emergency Medicine Practice* discusses the evaluation and treatment of high-morbidity hand injuries, with review of the current available evidence.

Critical Appraisal Of The Literature

A literature search was performed in Ovid MEDLINE®, PubMed, the National Guidelines Clearinghouse, and the Cochrane Database of Systematic Reviews. Articles included in the search were limited to human studies relevant to acute traumatic hand injuries published in English or translated into English. Search terms were individualized for each topic and included: *nail bed, subungual hematoma, jersey finger, mallet finger, extensor tendon,* and *scaphoid fracture.* The search yielded numerous review articles, case reports, cross-sectional analytical studies, multiple randomized controlled trails, and several Cochrane meta-analyses. The American Association of Hand Surgeons, American Academy of Orthopedic Surgeons, and American Society of Plastic Surgeons have no generalized guidelines on diagnosis and management of undifferentiated hand injuries.

The availability of meta-analyses of randomized controlled trial data (class I) is limited, and many current practice habits are based upon historical precedent, retrospective studies, and expert opinion (class II/III). The American College of Emergency Physicians (ACEP) published a set of guidelines regarding penetrating extremity injury in 1999.[10] The American College of Radiology (ACR) published guidelines on imaging modalities in acute hand and wrist trauma in 2013.[11] Major recommendations of these guidelines are included in **Table 1 (see page 3)**.

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Etiology And Pathophysiology

In the medical literature, hand injuries are often grouped by anatomical location. The mechanism of injury should cue the emergency clinician to consider specific diagnoses. For example, a fall on outstretched hand (FOOSH) should prompt consideration of scaphoid fracture, scapholunate instability, lunate dislocation, and perilunate dislocation. A motor vehicle crash with rapid deceleration while holding the steering wheel or a FOOSH injury while holding an object (eg, ski pole or bottle) should prompt consideration of gamekeeper's thumb. The most common injuries to the hand are lacerations (49.8%), fractures (15.3%), strains/sprains (8.4%), and contusions/abrasions (8%).[4] The key bones and joints of the hand and wrist are presented in **Figure 1.**

Differential Diagnosis

Time-sensitive limb-threatening injuries, high-morbidity injuries, and diagnoses detected solely by examination (eg, gamekeeper's thumb) deserve particular emphasis in patients presenting with acute hand injuries. **(See Table 2, page 4.)** Diligence is required in the trauma patient presenting with multisystem trauma or distracting injury (eg, open tibia-fibula fracture), as this scenario may lead to search-satisfying error (ie, the tendency to call off the diagnostic search once something is found).[12]

Prehospital Care

Key care components in the prehospital environment include identification of life-threatening injuries, hemorrhage control, collection of vital signs, neurovascular assessment, injury identification,

Table 1. Practice Guidelines For Emergency Department Management Of Hand Injury

Organization	Topic	Type	Recommendations
American College of Emergency Physicians[10]	Penetrating extremity trauma	Evidence-based **(Class II)**	• Irrigate wound under pressure • Debride devitalized tissue • Consider patient comorbidities associated with infection risk • Individualize decisions for wound closure • Update tetanus vaccination status as needed • Maintain low threshold for hand surgery consultation or follow-up
American College of Radiology[11]	Imaging in acute hand trauma	Expert consensus **(Class III)**	• Perform AP/lateral radiographs; consider oblique views for suspected fracture • Consider CT for suspected metacarpal fracture with negative x-ray • Consider CT for surgical planning • Consider MRI for suspected gamekeeper's thumb with negative x-ray* • Consider ultrasound as alternative to MRI in gamekeeper's thumb*

*These studies are nonemergent; patients may be placed in a splint and referred to a hand surgeon. See the section on gamekeeper's thumb, page 12.
Abbreviations: AP, anterior-posterior; CT, computed tomography; MRI, magnetic resonance imaging.

Figure 1. Bones And Joints Of The Left Hand

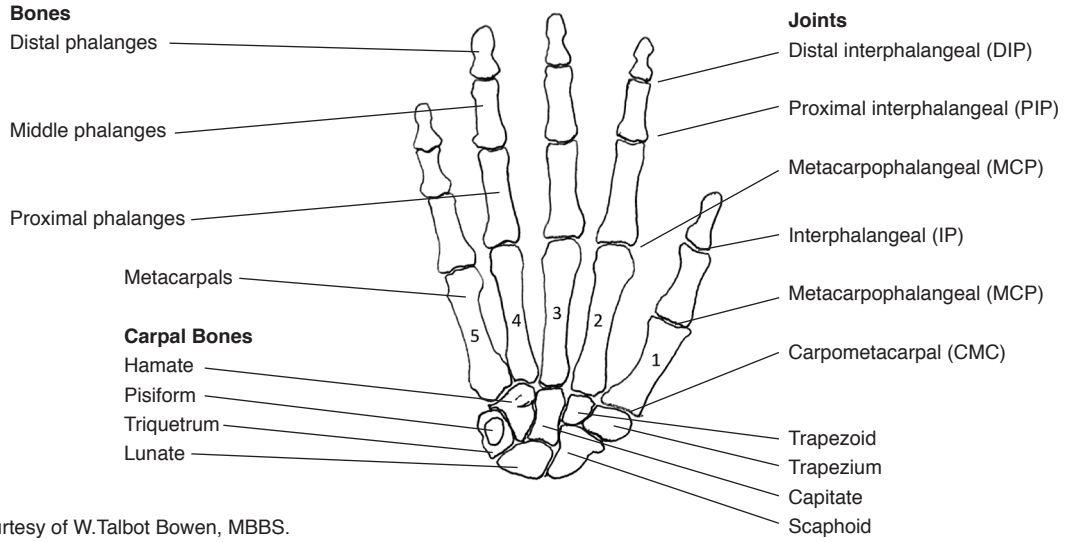


Image courtesy of W.Talbot Bowen, MBBS.

splinting, establishment of intravenous access, administration of parenteral analgesia, and appropriate storage of an amputated body part.

Bleeding control is first attempted with focal direct pressure and limb elevation. In brisk, poorly controlled arterial bleeding, a temporary tourniquet is a safe and effective option. When placed, the time must be recorded. Early removal of a potentially deleterious foreign body, such as a ring, is a critical intervention.

Splinting grossly misaligned partial amputations or fractures/dislocations may restore normal anatomical alignment and improve perfusion. In addition, splinting will minimize pain associated with movement. Following splint application, a repeat neurovascular assessment should be completed.

Appropriate storage of an amputated part entails wrapping the part in gauze moistened with normal saline or lactated Ringer's solution, and placing it into a plastic bag. This bag is then placed into a second bag containing ice and water. This method of storage reduces the risk of cold-induced injury and optimizes tissue viability.[13]

Prehospital emergency medical services (EMS) identification of the injury and/or unstable vital signs facilitates appropriate hand surgery, trauma center, and/or burn center utilization.

Emergency Department Evaluation

Triage And Stabilization

Initial ED triage, bed utilization, and care should follow standard practices for the undifferentiated trauma patient (eg, Advanced Trauma Life Support or emergency clinician discretion). Certain injuries necessitate immediate placement of the patient in a high-acuity care area to address life- or limb-threatening injuries. In instances of significant bleeding where there is anticipation of the need for disposition to the operating room, parenteral pain medications, or intravascular volume resuscitation, intravenous access should be obtained and the patient should remain NPO (nothing by mouth). Hemorrhage control, splinting, and parenteral analgesia should be undertaken as needed.

History

In hand trauma, a focused history risk-stratifies the differential diagnosis and possible complications (eg, retained foreign body, joint violation, tendon injury, infection, tetanus, rabies, and compartment syndrome). Particular emphasis is placed on rapid identification of limb-threatening and high-morbidity injuries. **(See Table 2.)** Information that may change the patient's ultimate disposition or alter management should be sought, such as in cases of a suicide attempt or suspicion of child abuse. If the patient is unable to offer a reliable history (eg, as with a child, or if the patient has an altered mental status), an attempt should be made to obtain information from an alternative source, such as from parents or EMS.[12]

A detailed description of the mechanism of injury and the symptoms should be sought, including asking whether the injury was from blunt force, penetrating force, FOOSH, closed fist, or high-pressure injection. The patient or witness should also be asked about the time of onset, pain, location, range of motion, functional impairment, exacerbating/relieving factors, weakness, numbness, tingling, and discoloration.[12] In certain situations (such as amputation), additional data are critical, including the method of storage of the body part and ischemic time. Knowledge of patient hand dominance, occupation, and hobbies are significant in surgical decision making in specific patient populations (eg, for a professional musician).

The patient's medical history should include baseline functional status, disability, prior injury, immunosuppression (eg, diabetes mellitus, asplenia, peripheral vascular disease), rheumatologic disease (eg, rheumatoid arthritis), bleeding disorders, current medications, allergies, smoking, and past surgical history.[12]

Physical Examination

A standardized hand examination is recommended for all patients with hand-related complaints. In some clinical circumstances, additional focused examination is recommended. **(See Table 3, page 5.)**

Physical examination begins with inspection and comparison with the unaffected hand for swelling, discoloration, bleeding, wounds, deformity, misalignment, amputation, and asymmetry. Palpation of the wrist joint, anatomical snuffbox, scapholunate joint, metacarpal bones, and metacarpophalangeal (MCP) joint, proximal interphalangeal (PIP) joint, and distal interphalangeal (DIP) joint in all digits

Table 2. Differential Diagnosis Of Acute Hand Injury

Presentation	Injury
Limb-threatening or very high morbidity	• Compartment syndrome • High-pressure injection injury • Arterial injury
High morbidity if missed or if diagnosis is delayed	• Occult scaphoid fracture • Rolando/Bennett fracture • Perilunate and lunate dislocation • Gamekeeper's thumb • Scapholunate dissociation • Fight bite
Moderate morbidity if missed	• Flexor tendon injury • Mallet finger • Jersey finger

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should be performed. Passive and active range of motion of all joints is performed at the wrist and at the MCP, PIP, and DIP joints, looking for evidence of limited range of motion, crepitus, and tenderness. Valgus and varus stress should be applied to the MCP, PIP, DIP, and thumb joints to assess for ligamentous instability.

Assessing Motor And Nerve Function

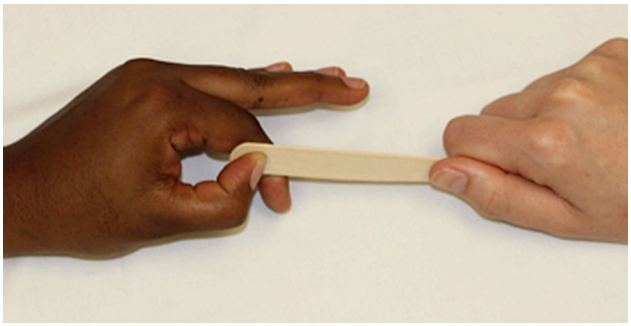
The motor components of the radial, median, and ulnar nerves are assessed with resistance to active thumb extension, thumb opposition, and thumb adduction, respectively. Froment sign is present when weakness in the adductor pollicis brevis muscle (due to ulnar nerve palsy) results in flexion of the thumb interphalangeal joint due to compensatory action of the flexor pollicis brevis, which is innervated by the median nerve. **(See Figure 2.)** The motor and sensory function of the radial, median, and ulnar nerves may be rapidly assessed with a set of simple maneuvers. **(See Figure 3, page 6.)** The sensory components of the radial, median, and ulnar nerves are assessed with light touch at the dorsal aspect of the thumb carpometacarpal joint, second digit pulp, and fifth digit pulp, respectively. **(See Figure 4, page 6.)**

Assessing Tendon Function

Extensor tendon examination is performed with the patient's hand immobilized on a stable surface, with resistance against extension at the MCP, PIP, and DIP joints.

The flexor system of digits 2 through 5 consists of flexor digitorum profundus (FDP), flexor digitorum superficialis (FDS), and the flexor tendon

Figure 2. Froment Sign



The thumb compensates for adductor pollicis brevis weakness secondary to ulnar nerve injury, with thumb interphalangeal joint flexion and opposition (functions of the median nerve).
Image courtesy of W. Talbot Bowen, MBBS.

Table 3. Physical Examination Of The Hand

Examination	Location/Finding
General inspection	• Swelling, discoloration, wound, deformity, bleeding • Suspicious puncture wound (fight bite)* • Boutonniere deformity (central slip extensor tendon injury)*
Palpation	• Point tenderness, crepitus • Anatomical snuffbox tenderness (scaphoid fracture)*
Passive and active range of motion	• Wrist • Digits 2-5: MCP, PIP, DIP joints • Thumb MCP, IP joints • Rotational deformity digits (metacarpal or phalanx fracture)*
Ligamentous stability	• Valgus and varus stress: PIP, DIP, MCP joints • Joint laxity 30° with radial stress: thumb MCP joint (gamekeeper's thumb)*
Flexor and extensor tendons	• FDS / FDP tendon in all digits at PIP/DIP joints, respectively • Extensor tendon
Radial nerve	• Thumb/wrist extension • Light touch or 2-point discrimination at dorsal thumb CMC joint
Median nerve	• Thumb opposition or abduction • Light touch or 2-point discrimination at digital pulp, second digit
Ulnar nerve	• Thumb adduction • Froment sign (ulnar nerve palsy)* • Light touch or 2-point discrimination at digital pulp, fifth digit
Vascular	• Pulsatile bleeding • Allen test • Relative difference of pallor or capillary refill (limited utility)

*Focused physical examination tests.
Abbreviations: CMC, carpometacarpal; DIP, distal interphalangeal; FDS, flexor digitorum superficialis; FDP, flexor digitorum profundus; IP, interphalangeal; PIP, proximal interphalangeal; MCP, metacarpophalangeal.

sheaths. The flexor pollicis longus (FPL) is the major flexor tendon of the thumb. The FDP inserts into the volar aspect of the distal phalanx. The FDS runs superficial to the FDP and inserts into the volar aspect of the middle phalanx.

Hand flexor tendons are assessed individually. To assess the FDP, the examiner holds the PIP in extension and the patient flexes at the DIP joint. To assess the FDS, the examiner immobilizes the other digits in extension while the patient flexes the non-immobilized digit. In open wounds, tendon examination requires direct visualization, in a bloodless field, to the base of the wound through full range of motion. **(See Figure 5, page 7.)**

Assessing Vascular Function

Vascular examination should identify gross injuries of the dual blood supply of the hand and/or evidence of impaired perfusion. Hard signs of arterial injury include bright-red pulsatile bleeding; expanding hematoma; a cold, pulseless extremity; a palpable thrill; or an audible bruit. Soft signs of arterial injury include impaired capillary refill and pallor. Capillary refill and pulse oximetry have limited diagnostic utility.[14,15,16]

The Allen test was originally devised to identify patients with a single radial artery supply of the hand. In suspected ulnar artery injury proximal to the wrist, the Allen test is performed. The hand is clenched and elevated 30°, and pressure is applied over the radial and ulnar arteries for 5 to 6 seconds. When the hand is unclenched and ulnar artery pressure is released, color should return to the hand. Persistence of pallor raises suspicion of abnormal ulnar artery patency.

Diagnostic Studies

Laboratory Studies

Complete Blood Count

The complete blood count has limited diagnostic utility in isolated hand trauma, particularly in the absence of significant bleeding or suspected coagulopathy. The platelet count may be useful in suspected coagulopathy or thrombocytopenia.[17]

Coagulation Studies

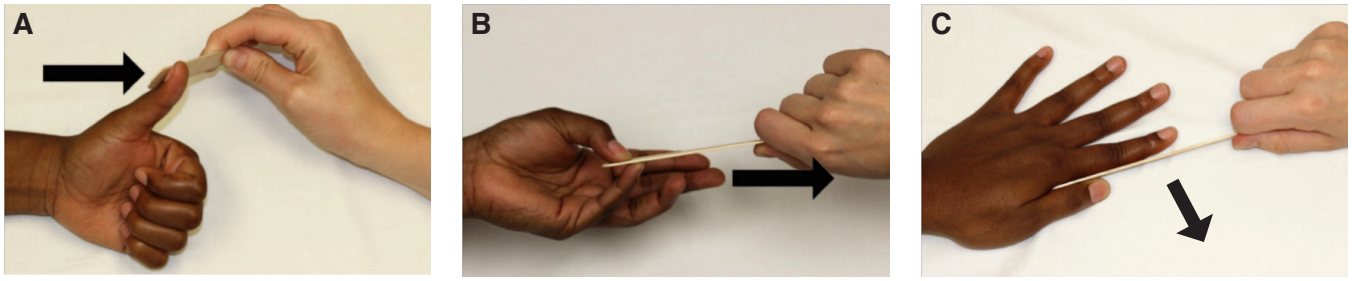
Coagulation studies (prothrombin time, international normalized ratio, activated partial thromboplastin time) are generally not indicated in acute hand trauma except with significant bleeding or suspected coagulopathy (eg, warfarin use, family history, or liver disease).

Imaging Studies

Plain Radiographs

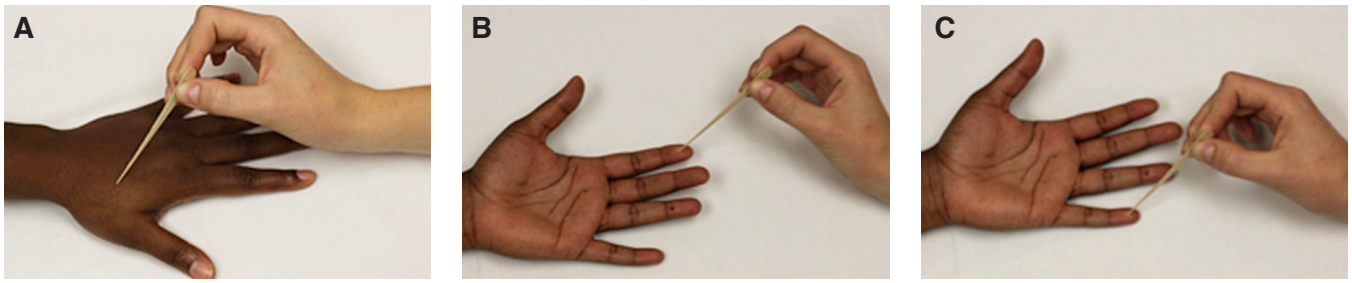
Unlike in suspected ankle or cervical spine fractures,

Figure 3. Motor Assessment Of Radial, Median, And Ulnar Nerves



View A: resistance to thumb extension (radial nerve). View B: resistance to thumb opposition (median nerve). View C: resistance to thumb adduction (ulnar nerve).
Image courtesy of W. Talbot Bowen, MBBS.

Figure 4. Physical Examination Of Radial, Median, And Ulnar Nerves



View A: radial nerve sensory assessment. View B: median nerve sensory assessment. View C: ulnar nerve sensory assessment.
Image courtesy of W. Talbot Bowen, MBBS.

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there are no prospectively validated clinical decision rules to omit imaging studies in very–low-risk patients with acute hand injury. In suspected fracture or joint injury, the initial imaging modality is plain radiography with anterior-posterior and lateral views, and consideration of an oblique view for overlapping bones.[18]

Hand radiographs should be systematically evaluated for adequacy of views, bony alignment, and individual bone morphology. In the posterior-anterior view of a normal hand, the middle metacarpal axis and radius axis should line up with one another, and the ulnar styloid should project laterally from the distal ulna. In the posterior-anterior view of the wrist, the carpal bones form 2 arches and 3 distinct smooth arcs (known as Gilula arcs). Irregularities in these smooth arcs signify ligamentous instability or fracture. Spacing between carpal bones should be limited to 2 mm. In the lateral view of the wrist, the middle metacarpal axis forms a line through the capitate, lunate, and radius. The scapholunate angle is formed by the longitudinal axis of the scaphoid and the lunate and normally measures 30° to 60°. Abnormal shapes of individual bones may signify pathology (eg, signet ring sign, pie-in-the-sky sign, spilled teacup sign, jumbled carpus).

Computed Tomography

Computed tomography (CT) is infrequently required in the ED. CT is more sensitive and specific than plain radiography to identify fractures.[11] The ACR supports CT imaging when clinical suspicion of occult fracture persists despite normal radiographs or when it is requested for surgical planning. Nonemergent CT imaging (eg, suspected metacarpal fracture despite normal radiographs) may be obtained in the outpatient setting.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) is very infrequently indicated in acute injuries of the hand in the ED. Although controversial, the ACR considers MRI as a diagnostic option for suspected scaphoid fracture with normal radiographs versus splinting, repeat examination, and radiographs at 10 to 14 days.[11,19,20] Nonemergent MRI in acute hand injury (eg, for occult scaphoid fracture, gamekeeper's thumb) may be obtained in the outpatient setting.

Ultrasonography

Several studies have shown that ultrasound imaging is a useful diagnostic imaging tool for acute hand injuries.[21-23] Wu et al prospectively studied 34 patients with suspected tendon injury (17 of whom had digit or hand injuries), comparing the diagnostic accuracy of emergency physician-performed bedside ultrasound versus physical examination. The authors reported equal sensitivities (100%); however, the specificity of ultrasound was superior to physical examination (95% vs 76%).[21] With appropriate training, emergency physician-performed bedside musculoskeletal ultrasound is a useful diagnostic tool. With the increasing emphasis on bedside ultrasound education during emergency medicine residency training, bedside musculoskeletal ultrasound may become more commonly performed.

Treatment

Fundamentals Of Treatment

Treatment of hand and wrist injury begins with appropriate analgesia and hemostasis. Wound care and splinting must be carefully provided to ensure a good outcome.

Analgesia

Local infiltration, digital nerve block, hematoma block, and ultrasound-guided regional nerve block using lidocaine or bupivacaine are the mainstays of procedural anesthesia for hand injuries in the ED. For more detailed information on pain management

Figure 5. Physical Examination Of Tendons



View A: assessment of extensor tendon. View B: assessment of FDP tendon. View C: assessment of FDS tendon.
Abbreviations: FDP, flexor digitorum profundus; FDS, flexor digitorum superficialis.
Image courtesy of W.Talbot Bowen, MBBS.

in the ED, with illustrations and procedure video links, see the August 2012 issue of *Emergency Medicine Practice*, "An Evidence-Based Approach To Traumatic Pain Management In The Emergency Department," at www.ebmedicine.net/PainManagement.

Two small prospective studies, Cannon et al and Williams et al, compared single volar injection digital nerve block with traditional 2-injection dorsal digital nerve block. They reported similar efficacies of patient analgesia and patient satisfaction with single-injection volar digital block versus traditional 2-injection dorsal digital block.[24,25] The traditional 2-injection dorsal digital nerve block is the preferred method of the authors of this review, due to the decreased sensitivity of the skin on the dorsum of the hand compared to the palm; however, both methods appear to be effective.

Hemostasis

Hemorrhage control is first attempted with focal direct pressure and elevation of the affected limb. In cases of inadequately controlled arterial bleeding, a temporary proximal tourniquet may be placed. Tourniquet time should always be documented and should not exceed 2 to 3 hours. Intermittent release of the tourniquet may be performed as needed. A glove "ring" tourniquet is an effective method to achieve adequate hemostasis during wound exploration in the digits. Arterial injuries should not be blindly clamped with an instrument or ligated with figure-of-eight suture due to the risk of damage to nearby underlying structures.

Wound Care

ACEP guidelines for wound care in penetrating trauma support pressure irrigation with normal saline or 1% povidone-iodine solution, debridement of devitalized tissue, removal of foreign contaminants, and gentle scrubbing, when necessary.[10] Pressure irrigation using an 18-gauge angiocatheter on a 35-mL syringe is superior to low-pressure irrigation techniques for reducing infection rates.[26-28] Hydrogen peroxide, 10% povidone iodine solutions, and chlorhexidine solutions have not been shown to be superior to sterile normal saline or tap water, and they are known to damage host cells responsible for wound healing.[29-31] A Cochrane review of 11 randomized controlled trials reported similar efficacy of potable tap water versus sterile water irrigation solutions for prevention of wound infections.[32] Wound care should not be delayed due to hand surgery consultation.

Many studies have reported no benefit of prophylactic antibiotics in hand and extremity lacerations that are at a low risk for infection.[33-39] Features associated with an increased risk of infection include tendon injury, open fracture, joint violation, crush injury, puncture wounds, wounds in an immunocompromised host, and wounds due to human or animal bites. High-risk wounds require empiric prophylactic antibiotics. Despite robust data refuting the benefit of prophylactic antibiotics for low-risk lacerations, there is no clear practice standard for the use of prophylactic antibiotics in hand lacerations.

In 2013, the Centers for Disease Control and Prevention (CDC) recommended combined Tdap vaccination for all patients aged > 10 years who require tetanus prophylaxis, regardless of the timing of their last tetanus (Td) immunization. The recommendation reflects concern for the increasing incidence of pertussis in the United States.[40] Current CDC recommendations for tetanus prophylaxis can be found at: http://www.cdc.gov/tetanus/pubs-tools/publications.html#articles.

Splinting

Splinting results in preservation of normal anatomical alignment and improved perfusion, and immobilization of the affected part provides pain control. Common splints used include thumb spica, volar, dorsal, radial gutter, and ulnar gutter splints. In general, the hand is immobilized in the intrinsic plus position.

Skin And Soft-Tissue Injury Treatment

Laceration

Most lacerations will undergo primary closure in the ED. Contraindications to ED primary repair include high infection risk, an infected wound, and injuries requiring repair by a hand surgeon (eg, crush injury, high-velocity missile injury, or in cases of significant tissue loss). While the risk of wound infection generally increases with time, wounds older than 6 hours are not an absolute contraindication to primary closure.[41] Patients with lacerations associated with a high risk of infection should receive prophylactic antibiotics, and these patients may be individually considered for delayed primary closure. Level I evidence demonstrates no effect upon wound infection rates with prophylactic antibiotics in low-risk hand lacerations.[33-35]

The ACEP guidelines on penetrating extremity trauma emphasize that the decision to perform primary closure is complex and should be determined on a case-by-case basis.[10]

Nonabsorbable simple interrupted sutures are most commonly used to achieve wound closure. The use of absorbable sutures is attractive, particularly in pediatric patients, due to their lack of a requirement for removal. A prospective randomized controlled trial by Karounis et al of 95 pediatric patients with lacerations at various sites (except the scalp) compared repair with absorbable sutures versus nonabsorbable sutures. The authors reported wound evaluation scores of 79 versus 66, respectively (with a score of 100 representing best possible cosmetic outcome); de-

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hiscence rates, 2% vs 11%, respectively; and infection rates, 0% versus 2%, respectively. Although the study demonstrated a trend toward superior outcomes with absorbable sutures, the study was inadequately powered to demonstrate a statistically significant difference.[42] The time interval to suture removal is generally 10 to 14 days, except for in the palm, which requires 14 to 21 days. Small linear lacerations in areas of low skin tension (such as the dorsum of the hand) may be amenable to a tissue adhesive.[43] Other small studies have reported noninferiority of absorbable sutures versus traditional nonabsorbable sutures in pediatric lacerations.[44,45] The current available evidence is limited, and an adequately powered randomized controlled trial is needed.

Fight Bite

A fight bite is a puncture wound over the exposed MCP or PIP joint of the dominant hand following clenched-fist contact with the fight opponent's teeth.[46] Sometimes, the patient will provide a history that is incongruent with the injury or will present days after the injury. This patient group is associated with a significant burden of psychiatric disease and substance abuse.[1,2]

Any wound overlying the MCP joint should raise suspicion of a fight bite. Physical examination should identify suspicious wounds, retained foreign body, infection, joint violation, tendon injury, and fracture. Three-view radiographs of the hand are recommended to identify fracture or retained foreign body.

Although it often appears innocuous, fight bite injury is associated with a high risk of structural and infectious complications. Following the introduction of oral and skin commensal organisms into the wound, the bacterial inoculum is dragged proximally into the joint, tendon sheath, and deep soft tissue. Infectious complications include tenosynovitis, septic arthritis, and osteomyelitis.[47,48] In a study of 191 patients with fight bite, Patzakis et al reported a complication rate of 75%, including joint violation (68%), tendon injury (20%), fracture (17%), and cartilage fragmentation (6%).[46]

All patients require thorough wound exploration through full range of motion, meticulous wound care, and prophylactic antibiotics. Primary closure is contraindicated. Suspicion of joint violation, tendon injury, or open fracture requires emergent consultation with a hand surgeon. Patients with cellulitis and/or abscess in delayed presentation require admission for surgical debridement and intravenous antibiotics.

The Infectious Diseases Society of America guidelines recommend empiric therapy with amoxicillin/clavulanate to cover oral commensal bacteria (eg, *Eikenella corrodens* and beta lactamase-producing anaerobes) and skin flora (eg, *Staphylococcus aureus* and *Streptococcus* species).[49]

Fingertip Amputation

Fingertip amputations are classified into zones I, II, or III injuries. **(See Figure 6.)** Early goals of care include appropriate storage of the amputated part, hemorrhage control, analgesia, and wound care. Two-view radiographs are recommended to identify fracture.

Zone I injuries, in which no bone is exposed, undergo wound care followed by placement of a nonadherent dressing and healing by secondary intention. Lamon et al performed a study of 25 consecutive patients with zone I injuries who underwent conservative management with wound care, semiocclusive dressing, and healing by secondary intention. In these patients, the authors reported preservation of finger length, normal sensory function in 88%, infection rate of 0%, and mean epithelialization time of 29 days.[50]

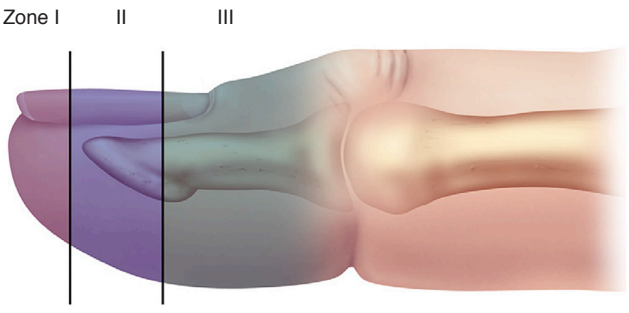
Zones II and III injuries undergo wound care, rongeur of exposed bone, and wound closure, followed by placement of a nonadherent dressing. Severe zone III injuries may require distal phalanx amputation. The decision to perform ronguer of bone and closure should be guided by emergency clinician familiarity with the procedure and hand surgeon availability. Follow-up with a hand surgeon is recommended. Patients should be advised of the typical healing time (ie, 3-6 weeks).[50] Replantation strategies for fingertip amputation are controversial.[50-53]

Nail Plate And Nail Bed Injury Treatment

Subungual Hematoma

A subungual hematoma is a collection of blood between the nail plate and nail bed matrix. Two-view radiographs are recommended for injuries suspicious for distal phalanx fracture. Until relatively recently, it was common practice to perform nail plate removal and exploration of the nail bed for all subungual hematomas > 50% of the nail plate.[54,55] Current evidence supports nail trephination alone for subungual hematoma of any size without nail plate disruption.[55,56] See the section, "Subungual Hematoma: To Remove The Nail Or Not?," page 19.

Figure 6. Zones Of The Fingertip



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Nail Bed Matrix Injury

Open nail bed matrix injuries are associated with nail plate deformity and functional impairment of the fingertip. Nail plate injuries with nail bed matrix injury require nail plate removal and nail bed matrix repair.[56] Nail bed lacerations are repaired with 6-0 absorbable suture followed by splinting of the eponychial fold with the nail plate. The decision to perform repair in the ED versus by a hand surgeon repair may be guided by emergency clinician familiarity with the procedure and hand surgeon availability. Following ED repair, all patients are referred to a hand surgeon.

Tendon Injury Treatment

Strain Injury

A strain is an injury of a tendon and/or muscle during active contraction or stretching. Injury ranges from mild tearing to complete disruption of the musculotendinous unit.[57] Treatment for mild injuries includes rest, ice, compression/immobilization, elevation, and nonsteroidal anti-inflammatory drugs (NSAIDs), followed by graduated rehabilitation when injury is clinically improved. Grade III strain injuries (ie, complete disruption of the musculotendinous unit) require splinting and referral to a hand surgeon.

Flexor Tendon Injury

The 2 most common mechanisms of flexor tendon injury are laceration from a sharp object, followed by forced extension during finger flexion.[58] Diagnosis is founded upon direct visualization during wound exploration or evidence of impaired flexion. Ultrasonography has been shown to be a useful adjunct to physical examination.[59,60] **(See Figure 7.)** Radiographs are recommended to identify fracture and foreign body.

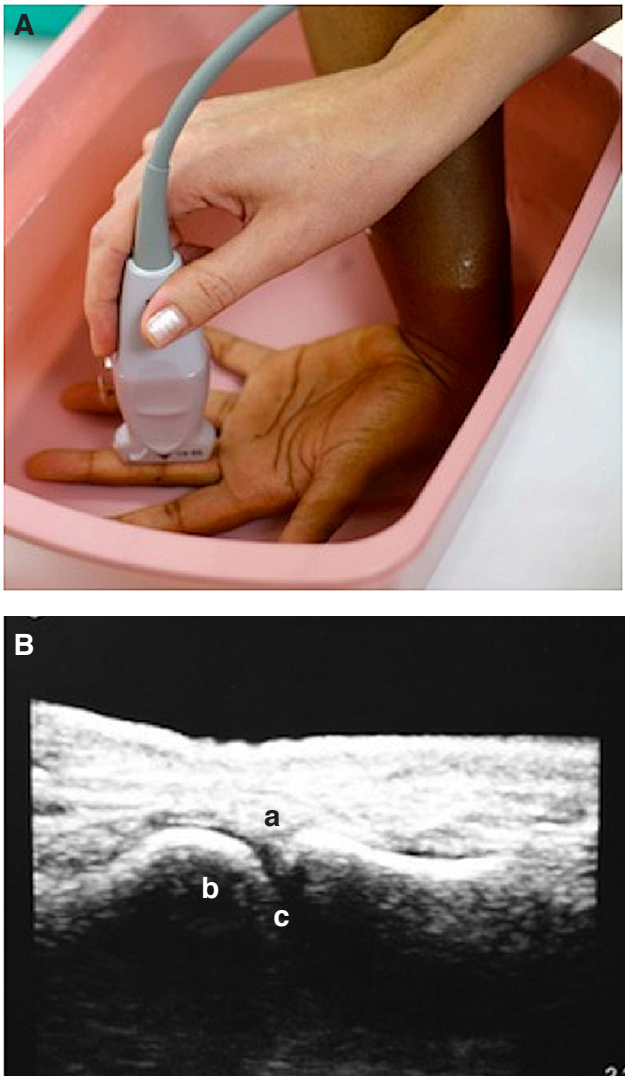
All flexor tendon injuries (FDP, FDS, and FPL) require referral to a hand surgeon no later than 7 days after the injury. When possible, specific follow-up instructions should be discussed with the hand surgeon on call and they should be given to the patient. Open injuries are sutured closed in the ED, a nonadherent dressing is placed, and a dorsal splint in applied in the intrinsic plus position prior to ED discharge. **(See Figure 8, page 11.)** Prophylactic antibiotics (eg, cephalexin) are frequently prescribed for open flexor tendon injuries, although there is limited evidence to support or refute this practice.[61]

Jersey Finger

Jersey finger is a closed injury of the FDP tendon distal to the DIP joint. The most common mechanism is forced extension of the DIP joint during active flexion. The name originates from the initial description in 1977 of rugby players who sustained finger injury by holding on to the jerseys of their opponents as they were running away. The dominant ring finger is most commonly affected due to its relative anatomic weakness and degree of protrusion in the grasping position.[62,63]

The diagnosis is made by physical examination with evidence of DIP swelling, volar DIP tenderness, and impaired DIP flexion. Radiographs are recommended to identify fracture or dislocation. Ultrasonography may differentiate between partial- and full-thickness FDP rupture and may localize the distal tendon stump.[59,62] Jersey finger requires dorsal hand and wrist splint application in the intrinsic plus position and referral to a hand surgeon for tendon repair within 7 days.

Figure 7. Emergency Physician Bedside Ultrasonography



View A: the high-frequency linear transducer is used with the patient's hand placed in a water bath. The flexor tendon can be assessed through full range of motion. View B: Ultrasound longitudinal view of flexor tendon (a), middle phalanx (b), and proximal interphalangeal joint (c).
Image courtesy of W. Talbot Bowen, MBBS.

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Extensor Tendon Injury

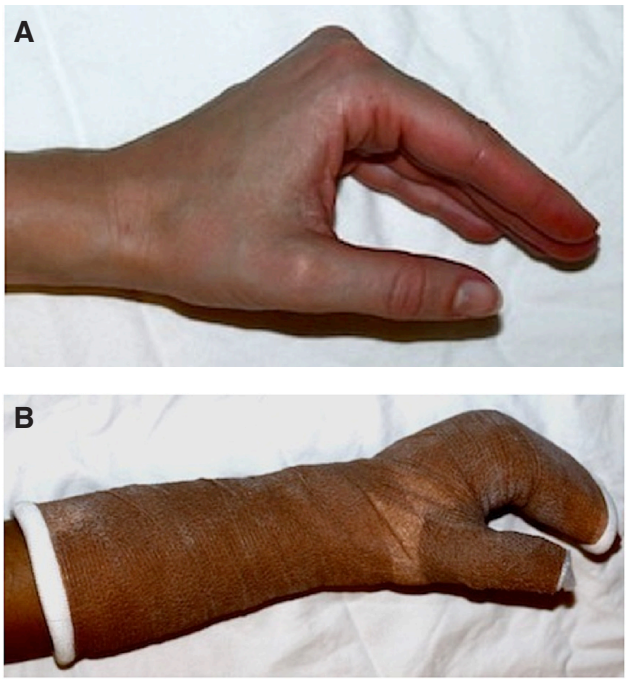
Extensor tendon injuries are classified in zones I-VII. **(See Table 4.)** The 2 most common mechanisms are laceration and forced flexion against active extension.[64,65] Diagnosis is based upon physical examination, with evidence of limited extension or direct visualization during wound exploration. Radiographs are recommended to identify fracture.

The extensor tendon mechanism is anatomically complex. Closed extensor tendon injuries require volar splinting in extension and follow-up with a hand surgeon within 7 days. There are 2 management options for open tendon injury: (1) repair the tendon in the ED, or (2) simply close the wound with the tendon unrepaired, apply a splint, and refer the patient to a hand surgeon for delayed repair within 7 days. Injuries with gross contamination, fracture, neurovascular injury, and thumb involvement, and in specific patient populations (eg, those with rheumatoid arthritis, professional athletes, etc) should be considered for consultation for repair by a hand surgeon.

In general, extensor tendon repair in the ED is considered for open, grades II-IV extensor tendon injuries. The decision to perform repair in the ED should be guided by emergency clinician familiarity with the procedure and hand surgeon availability. ED extensor tendon repair in patients with rheumatologic disease (such as rheumatoid arthritis) is not advised due to high rates of complications in these patients. Repair in the ED is achieved with 4-0 or 5-0 nonabsorbable braided suture with a tapered needle. Techniques vary, based upon the injury zone.[66,67]

It is common to prescribe prophylactic antibiotics for open tendon injuries of the hand, despite limited evidence to support this practice.

Figure 8. Intrinsic Plus Splinting Position



View A: intrinsic plus position, with wrist dorsiflexion at 30°, metacarpophalangeal joint flexion at 80°-90°; View B: intrinsic plus and volar splint.

Image courtesy of W. Talbot Bowen, MBBS.

Table 4. Grade Of Extensor Tendon Injury, By Location

Grade I: DIP joint
Grade II: Middle phalanx
Grade III: PIP joint
Grade IV: Proximal phalanx
Grade V: MCP joint
Grade VI: Metacarpal
Grade VII: Wrist joint

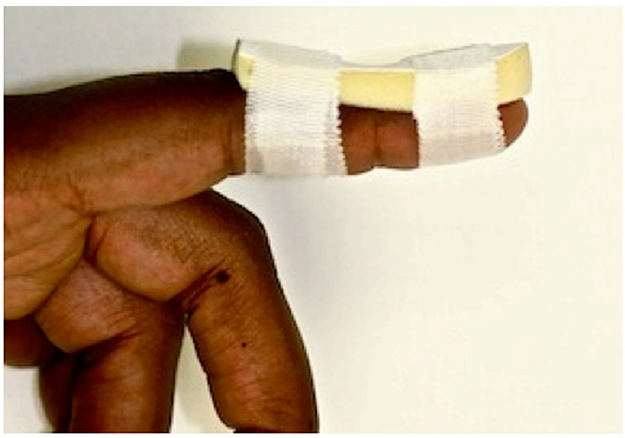
Abbreviations: DIP, distal interphalangeal; MCP, metacarpophalangeal; PIP, proximal interphalangeal.

Mallet Finger

Mallet finger is an injury of the extensor tendon distal to the DIP joint. It is most commonly due to forced flexion of the DIP joint during extension. The injured digit may be held in fixed flexion, somewhat resembling a mallet. The third, fourth, and fifth digits of the dominant hand are most commonly affected. Radiographs should be obtained to identify avulsion fracture.

Uncomplicated mallet finger requires a splint immobilizing the DIP in extension and allowing full range of motion of the PIP joint. **(See Figure 9.)** A study by Katzman et al of 32 cadavers demonstrated that DIP splinting alone immobilizes the extensor tendon equally effectively, versus combined DIP/PIP splinting.[68] Patients are referred to a hand surgeon.[68,69]

Figure 9. Mallet Finger Splint



Dorsal splint spans the distal interphalangeal joint in extension.

Image courtesy of W.Talbot Bowen, MBBS.

A 2008 Cochrane review reported no significant difference between various commercially available splints for mallet finger. The authors concluded that splint durability is associated with better patient compliance.[69]

Treatment Of Ligamentous Injury

Sprain

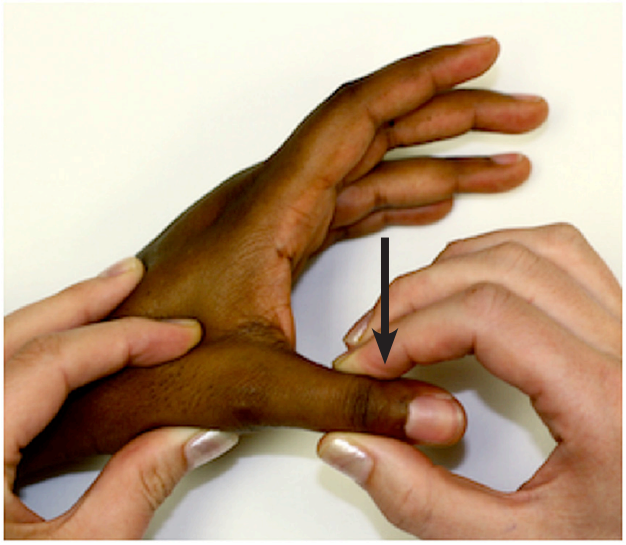
Ligamentous injury ranges from mild injury to partial tear, to complete tear with joint instability (grade 3 sprain). Uncomplicated sprain is treated with rest, ice, compression/immobilization as tolerated, elevation, and NSAIDs.[57]

Gamekeeper's Thumb (Skier's Thumb)

Gamekeeper's thumb is an injury of the ulnar collateral ligament (UCL) at the MCP joint of the thumb. Debilitating weak pinch and grasping function due to ineffective thumb adduction and opposition may occur if untreated. This injury most commonly occurs with rapid deceleration while grasping an object (eg, a ski pole or a steering wheel).

The diagnosis is made upon physical examination. Swelling and tenderness may be present along the ulnar base of the thumb. The examiner should assess the UCL by applying radial stress on the thumb with the MCP joint in mild flexion. **(See Figure 10.)** Joint laxity > 30° or > 15° of relative joint laxity is diagnostic of complete UCL tear. Both thumbs must be examined.[70]

Figure 10. Physical Examination For Suspected Gamekeeper's Thumb



Application of radial stress on the thumb (arrow) with the metacarpophalangeal joint in mild flexion assesses ulnar collateral ligament laxity of the thumb (gamekeeper's thumb). The unaffected side should also be assessed.

Image courtesy of, W. Talbot Bowen, MBBS.

Radiographs are recommended to identify associated avulsion fracture or dislocation. In a study by Heyman et al of 23 patients with UCL tear, 89% of patients had entrapment of the adductor pollicis aponeurosis between the ruptured ends of the UCL (ie, Stener lesion).[71] A Stener lesion impedes UCL healing and requires surgical repair.[72,73]

Patients with a clinical suspicion of gamekeeper's thumb require a thumb spica splint and referral to a hand surgeon within 7 days.

Treatment Of Dislocations

DIP, PIP, and MCP dislocations are often suspected on initial inspection. Dorsal DIP and PIP dislocation are most common. Radiographs are advised to exclude fracture and confirm dislocation.

Patients with closed DIP, PIP, and MCP dislocation often require digital nerve block prior to closed reduction. Most acute DIP and PIP dislocations are easily reduced on the first attempt. In select patients, after counseling and consent, a single rapid joint reduction attempt without digital nerve block may be considered. Reduction is achieved with distraction traction-counter traction. Inability to reduce the joint requires hand surgeon consultation. Following reduction, all patients require splinting in extension, neurovascular reassessment, confirmatory postreduction radiographs, and referral to a hand surgeon.

Scapholunate Dissociation

Scapholunate dissociation results from injury of the scapholunate interosseous ligament. The most common mechanism is a high-impact FOOSH with wrist hyperextension and ulnar deviation.[74] **(See Figure 11, page 13.)**

Physical examination reveals wrist swelling, point tenderness over the scapholunate joint, and decreased range of motion. Patients should be risk-stratified for scaphoid fracture, as the typical mechanism of injury is similar.

Patients with scapholunate diastasis > 3 mm,[75,66] or clinical suspicion of scapholunate dissociation with equivocal imaging are placed in a thumb spica splint and referred to a hand surgeon. Scapholunate dissociation may require nonemergent surgical intervention to decrease the risk of severe and debilitating wrist dysfunction.

Perilunate Dislocation And Lunate Dislocation

Perilunate dislocation and lunate dislocation are typically discussed together. They most commonly occur due to a high-impact FOOSH injury with wrist hyperextension. Physical examination may demonstrate swelling and deformity of the wrist, point tenderness over the dorsal aspect of scapholunate joint, and decreased range of motion.[77]

Posterior-anterior radiographs of the wrist are abnormal in perilunate and lunate dislocation;

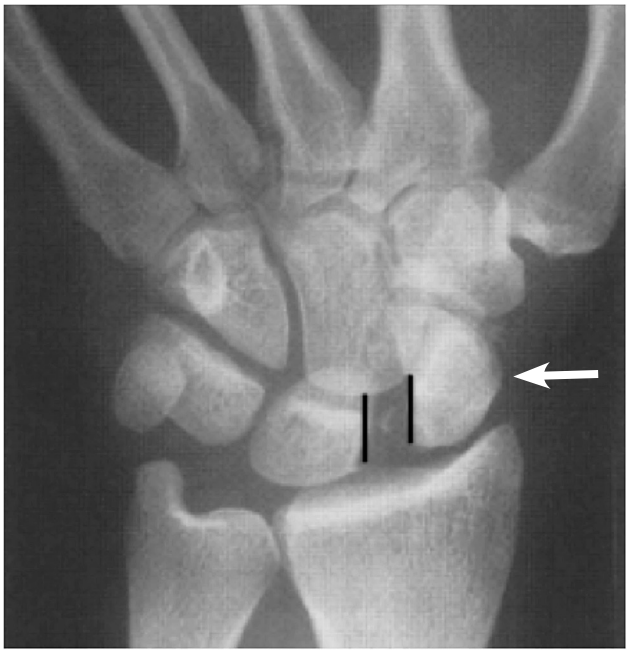
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however, lateral views depict a greater degree of carpal bone displacement. Careful radiographic review (with particular attention to the lateral view) should be undertaken because missed injuries occur frequently. A 1993 study by Herzberg et al of 166 patients with perilunate dislocation reported a rate of missed injury of 25%.[78]

In perilunate dislocation, the lateral radiograph demonstrates displacement of the capitate (typically dorsal) with retention of the lunate articulation with the radius. **(See Figure 12, view A.)** The posterior-anterior view demonstrates loss of the continuity of the 3 carpal arcs and is referred to as "jumbled carpus." **(See Figure 12, view B.)**

In lunate dislocation, the lateral radiograph shows displacement and rotation of the lunate (usually volar), known as the "spilled teacup" sign. **(See Figure 13, view A.)** In lunate dislocation, the posterior-anterior view demonstrates a triangle-shaped lunate, known as the "pie in the sky" sign. **(See Figure 13, view B.)** Closed reduction of lunate dislocation and perilunate dislocation is often technically difficult. Emergent consultation with a hand surgeon is recommended to coordinate closed reduction versus open reduction and fixation in the operating room.[78]

Figure 11. Plain Radiograph In Scapholunate Dissociation



Posterior-anterior wrist radiograph with > 3 mm of scapholunate diastasis marked. This is known as the "Terry Thomas" sign or "David Letterman" sign (referencing the gap in these perfomers' teeth). The cortical ring sign is present with rotation and foreshortening of the scaphoid bone (arrow).

From Hill S, Wasserman E. "Wrist Injuries: Emergency Department Imaging And Management. *Emergency Medicine Practice,* 2001, Volume 3, issue 11. Reprinted with permission. www.ebmedicine.net.

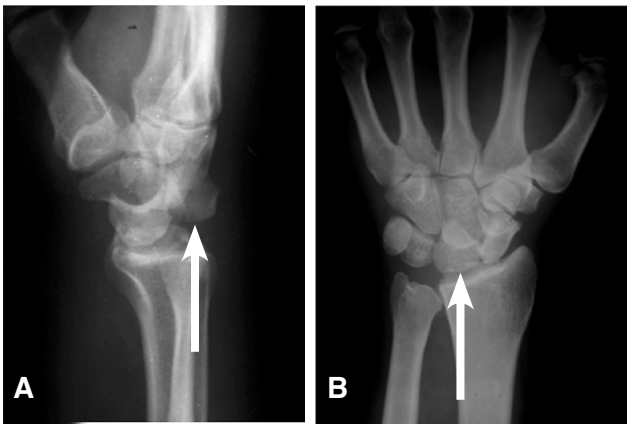
Treatment Of Fractures

Fractures Of Phalanges 2, 3, 4, 5

Distal Phalanx

Distal phalanx fractures are classified into 3 categories: (1) tuft, (2) shaft, or (3) base factures. Focused physical examination should identify point tenderness and associated nail plate injury, tendon injury, or

Figure 12. Plain Radiograph In Perilunate Dissociation



View A: lateral view with dorsal displacement of the capitate bone. View B: posterior-anterior view demonstrating jumbled carpus.

From Hill S, Wasserman E. "Wrist Injuries: Emergency Department Imaging And Management." *Emergency Medicine Practice,* 2001, Volume 3, Issue 11. Reprinted with permission. www.ebmedicine.net

Figure 13. Plain Radiograph In Lunate Dissociation



View A: spilled teacup sign present on lateral view. View B: pie in the sky sign on posterior-anterior view.

From: John H. Harris, Jr., William H. Harris, Robert A. Novelline. *The Radiology of Emergency Medicine.* Third edition. Wolters Kluwer Health, 1993. Used with permission.

Clinical Pathway For Management Of Hand Injuries (Continued on page 15)

METACARPAL FRACTURES

Metacarpal fracture, uncomplicated	• Reduce, splint, and refer to hand surgeon **(Class II)**
Metacarpal fracture, complicated*	• Emergent consult with hand surgeon **(Class II-III)**

FINGER FRACTURES

Phalanx fracture, complicated*	• Emergent consult with hand surgeon **(Class II-III)**
Distal phalanx fracture, uncomplicated	• Reduce, splint, and refer to hand surgeon **(Class II)**
Middle or proximal phalanx fracture, uncomplicated	• Reduce, splint, and refer to hand surgeon **(Class II)**

OPEN FRACTURES

Tuft fracture, distal phalanx, open	• Wound care, wound closure, splint, and refer to hand surgeon **(Class III)**
All other open hand fractures	• Emergent consult with hand surgeon **(Class II-III)**

DISLOCATIONS/LIGAMENT INJURIES

Scapholunate instability	• Splint and refer to hand surgeon **(Class III)**
DIP, PIP, MCP dislocation	• Reduce, splint, and refer to hand surgeon **(Class III)**
Lunate dislocation	• Emergent consult with hand surgeon **(Class III)**
Perilunate dislocation	• Emergent consult with hand surgeon **(Class III)**
Gamekeeper's thumb	• Splint and refer with hand surgeon **(Class III)**

*Inability to achieve postreduction goals, rotational deformity, or displaced intra-articular fractures.
Abbreviations: DIP, distal interphalangeal; MCP, metacarpophalangeal; PIP, proximal interphalangeal.
For classes of evidence definitions, see page 16.

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Clinical Pathway For Management Of Hand Injuries (Continued from page 14)

TENDON INJURIES

Flexor tendon, closed	• Splint and refer to hand surgeon **(Class III)**
Flexor tendon, open	• ED wound care, loose primary closure, splint, and refer to hand surgeon **(Class III)** • Consult hand surgeon for operative planning **(Class II)**
Jersey finger, mallet finger	• Splint and refer to hand surgeon **(Class III)**
Extensor tendon, closed	• Splint and refer to hand surgeon **(Class III)**
Extensor tendon, open	• Wound care, wound closure, splint, and refer to hand surgeon **(Class II)** • Consider ED repair for injuries to zones II-IV **(Class III)**

LACERATIONS AND MISCELLANEOUS INJURIES

High-pressure injection injury	• Emergent consult with hand surgeon **(Class II)** • Antimicrobial prophylaxis **(Class III)** • Avoid regional nerve block **(Class III)**
Fight bite	• Consider emergent consult with hand surgeon **(Class II)** • Antimicrobial prophylaxis (amoxicillin/clavulanate) **(Class II)**
Compartment syndrome	• Emergent consult with hand surgeon **(Class II)**
Subungual hematoma, uncomplicated†	• Nail plate trephination alone **(Class II)**
Subungual hematoma with nail plate disruption‡	• ED nail plate removal and nail bed matrix repair **(Class II-III)** • Consider consult with hand surgeon for nailbed matrix repair **(Class III)**
Fingertip amputation	• ED repair and refer to hand surgeon, zones I-III **(Class III)** • Consider consult with hand surgeon for surgical repair, zone III **(Class II-III)**

†Absence of nail plate or margin disruption with or without uncomplicated tuft fracture.
‡Nail plate, stellate nail plate injury, complicated distal phalanx fracture.
Abbreviation: ED, emergency department.
For classes of evidence definitions, see page 16.

open fracture. Anterior-posterior and lateral radiographs are recommended.[11]

Displaced, closed distal phalanx fractures require reduction, followed by a volar digital splint immobilizing the DIP joint. All patients are referred to a hand surgeon.

Based on the evidence, prophylactic antibiotics confer no benefit to low-risk open tuft fractures. Stevenson et al performed a double-blind randomized controlled trial of 193 patients with low-risk open distal phalanx fractures, all of whom underwent meticulous wound care in the ED and were then randomized to flucloxacillin versus placebo. No significant difference in wound infection rates was found (3%, and 4%, respectively; $P > .05$).[79] Low-risk open tuft fractures require meticulous wound care, followed by reduction, primary closure, and a volar digital splint. High-risk open tuft fractures may benefit from prophylactic antibiotics.

Middle And Proximal Phalanx

Middle and proximal phalanx fractures are relatively more susceptible to rotational forces. Physical examination should identify rotational deformity (ie, scissoring of the digits with flexion), tendon injury, and open fracture. Two-view radiographs are recommended.

Displaced fractures require digital nerve block, closed reduction, and splinting. Proximal phalanx fractures in digits 2 and 3 require a radial gutter splint, while digits 4 and 5 require an ulnar gutter splint. Following splint application, all patients require neurovascular reassessment and confirmatory postreduction radiographs. All patients are referred to a hand surgeon.

Emergent hand surgery consultation is recommended for open fractures. The inability to reduce the fracture fragment, > 10° angulation, 2 mm shortening, any rotational deformity, and intra-articular fractures with involvement of > 30% of the articular surface require either hand surgeon consultation or urgent referral.[80]

Fractures Of Metacarpals 2, 3, 4, 5

Fractures of metacarpals 2, 3, 4, and 5 are classified into 4 categories: (1) base, (2) shaft, (3) neck, and (4) head fractures. Physical examination should identify rotational deformity, fight bite injury, neurovascular injury, compartment syndrome, and open fracture. Three-view radiographs of the hand are recommended.[11]

Metacarpal base fractures are uncommon and usually result from axial loading on the metacarpal due to a fall with the elbow extended.[81] Displaced closed metacarpal base fractures require reduction, splinting, and referral.

Metacarpal shaft fractures may result from closed-fist injury or high-energy impact injury. Displaced closed metacarpal shaft fractures require adequate reduction, splinting, and referral.

Reduction criteria for metacarpal shaft and neck fractures are presented in **Table 5.** A radial gutter splint is recommended for fractures of metacarpals 2 and 3, and an ulnar gutter splint is recommended for fractures of metacarpals 4 and 5. The hand should be immobilized in the intrinsic plus position. **(See Figure 8, page 11.)** Analgesia during closed reduction may be achieved with a fracture hematoma block. All patients undergoing closed reduction require splinting, neurovascular assessment, and confirmatory postreduction radiographs.

Table 5. Acceptable Degree Of Angulation In Metacarpal Shaft And Neck Fractures

Digit	Metacarpal Shaft Fractures	Metacarpal Neck Fractures
2	0°	10°
3	0°	15°
4	20°	30°
5	30°	40°

Reprinted from *Hand Clinics*, Volume 29, issue 4. Rafael Diaz-Garcia, Jennifer F. Waljee. "Current Management of Metacarpal Fractures." Pages 507-518. 2013. With permission from Elsevier.

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

Level of Evidence:
- Generally higher levels of evidence
- Nonrandomized or retrospective studies: historic, cohort, or case control studies
- Less robust randomized controlled trials
- 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

This clinical pathway is intended to supplement, rather than substitute for, professional judgment and may be changed depending upon a patient's individual needs. Failure to comply with this pathway does not represent a breach of the standard of care.

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Metacarpal head fractures are rare. They are usually comminuted and associated with significant cartilage and/or joint disruption.

Boxer's Fracture

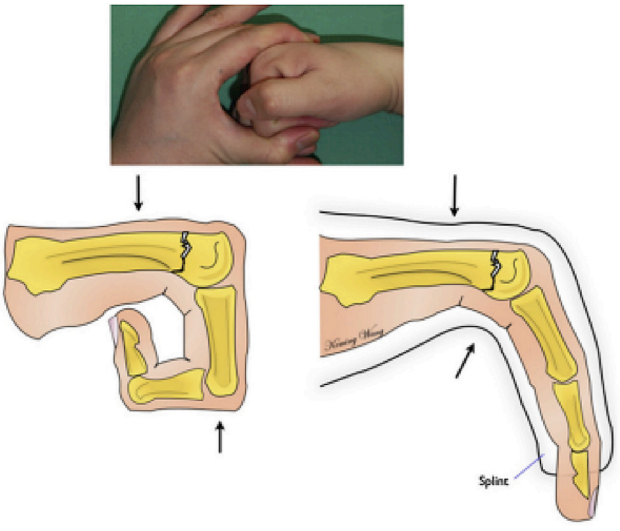
The most common mechanism of metacarpal neck fracture is closed-fist injury. A boxer's fracture is a fifth metacarpal neck fracture, and it accounts for 20% of hand fractures.[82] Closed reduction of a metacarpal neck fracture is achieved via the Jahss maneuver[83] **(See Figure 14)** or the 90-90 maneuver. A 2005 Cochrane review meta-analysis reported that there is insufficient evidence to demonstrate superiority between various splinting techniques for closed boxer's fracture.[84]

Following splint application, all patients require neurovascular reassessment and confirmatory postreduction radiographs. All patients are referred to a hand surgeon. Patients with suspected occult fracture should be splinted and referred to a hand surgeon. Emergent consultation with a hand surgeon is recommended for open fracture, associated fight bite injury, inability to reduce the fracture, and any rotational deformity.[85]

Thumb Fractures

Thumb fractures are classified into 3 categories: (1) phalangeal, (2) metacarpal, (3) and intra-articular metacarpal base fractures. Physical examination should identify point tenderness, rotational deformity, and open fracture. Dedicated thumb radiographs are recommended. When diagnostic uncertainty persists despite normal radiographs, a Roberts view (ie, true anterior-posterior thumb view) may be considered.

Figure 14. The Jahss Maneuver



The metacarpophalangeal and interphalangeal joints are placed in flexion at 90°. Axial pressure on the proximal phalanx is then applied to reduce the metacarpal fracture.

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Phalangeal And Metacarpal Shaft Fractures

Closed transverse nonarticular thumb phalanx and metacarpal shaft fractures require closed reduction, thumb spica splinting, and referral. Indications for emergent hand surgery consultation include open fracture, inability to reduce the fracture, > 30° angulation, and any rotational deformity.[86]

Intra-Articular Fractures Of The Thumb Metacarpal Base: Bennett And Rolando Fractures

The most common mechanism of intra-articular fractures of the base of the thumb is axial loading. A Bennett fracture is a 2-part intra-articular fracture dislocation or subluxation of the base of the thumb metacarpal. A Rolando fracture is a Y-shaped comminuted fracture dislocation of the base of the thumb metacarpal.[86]

Bennett and Rolando fractures are associated with a high risk of degenerative joint disease and functional limitation at the first carpometacarpal joint. Fracture reduction is achieved via axial traction, opposition of the thumb metacarpal joint, and radial pressure over the metacarpal base. Patients require a thumb spica splint. Following splint application, all patients require neurovascular reassessment and confirmatory postreduction radiographs. All patients are referred to a hand surgeon.[86-90] Patients with suspected occult fracture should be splinted and referred to a hand surgeon.

Carpal Fractures

Scaphoid Fracture

Scaphoid fracture most commonly occurs following a FOOSH injury. Complications of scaphoid fracture include avascular necrosis and scapholunate advanced collapse. These sequelae may be functionally devastating. Physical examination should identify anatomical snuffbox tenderness and tenderness with axial loading of the thumb. A 2014 meta-analysis by Carpenter et al demonstrated that the absence of snuffbox tenderness has the lowest negative likelihood ratio of any physical examination maneuver for scaphoid fracture (odds ratio, 0.15; 95% confidence interval, 0.05-0.43).[91]

Wrist radiographs, including a dedicated scaphoid view, are recommended. Plain radiographs are not adequately sensitive to exclude scaphoid fracture. Initial radiographs may be normal in up to 20% of cases.[11]

A randomized prospective trial by Clay et al of 392 patients with scaphoid wrist fractures compared thumb spica splinting and volar wrist splinting. The authors reported no significant difference in nonunion rates (10% for both groups), but 100

patients were lost to follow-up.[92] Application of a thumb spica splint is recommended. In patients with suspected occult scaphoid fracture despite normal radiographs, splinting and referral to a hand surgeon is recommended. Radiographs are repeated in 10 to 14 days.[11]

Vascular Injury Treatment

The arterial blood supply to the hand consists of an elegant series of coupled vessels: the radial and ulnar arteries, deep and superficial palmar arches, and the transverse arcades of the digital arteries. **(See Figure 15.)** Functional redundancy in the system of arterial blood flow prevents ischemia or infarction in isolated arterial vessel injury.

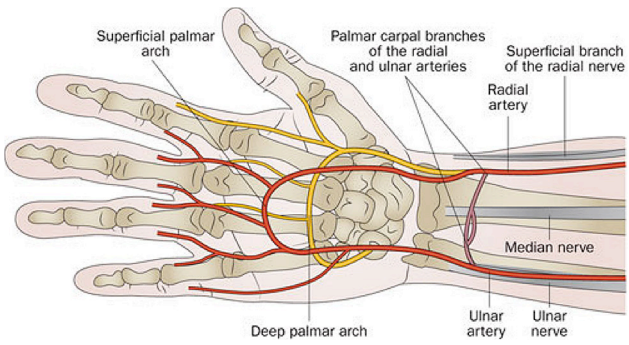
Hard signs of vascular injury such as bright-red pulsatile bleeding; expanding hematoma; a cold, pulseless extremity; or a palpable thrill or audible bruit require emergent consultation with a vascular surgeon.

Nerve Injury Treatment

The median, ulnar, and radial nerves innervate the hand. The surgical management and prognosis of nerve injuries to the hand depend predominantly on the mechanism of injury. Blunt injury results in axonotmesis (ie, injury to the nerve cell axon with intact endoneurium).[93,94] Nerve regeneration via the intact endoneurium may occur over weeks to months. In penetrating injury, the nerve and endoneurium are often severed, and spontaneous regeneration is very unlikely without surgical intervention. Emergent hand surgery consultation is recommended for penetrating nerve injuries. Patients with nerve injuries are splinted in the intrinsic plus position and are referred to a hand surgeon.

Patients should be educated regarding the possible complications of nerve injury, including impaired nerve regeneration, chronic sensory disturbances, and chronic pain.[93]

Figure 15. Arterial Anatomy Of The Hand



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Special Circumstances

High-Pressure Injection Injuries

High-pressure injection injuries, despite initially appearing innocuous, carry a high risk of wound infection, tissue necrosis, compartment syndrome, and amputation.[95] Experimental and postoperative studies have demonstrated that injected material is deposited along neurovascular bundles via the path of least resistance.[95] The typical patient is a male carpenter or painter who inadvertently injected his nondominant index finger testing the nozzle of a clogged high-pressure paint gun. Injuries with injected organic solvents (such as paint, paint thinner, gasoline, or oil) are associated with a high risk of complications.[96] Injuries from high-pressure injection of water, air, or veterinary medications carry a relatively lower risk than organic or solvent material, but ED management is the same.[96]

The history should include the type and volume of the material injected and the pressure (psi) at which it was injected. Physical examination identifies the puncture site and assesses range of motion, neurovascular function, and evidence of compartment syndrome. Radiographs are obtained in an attempt to determine the distribution of the injected material.

Goals of care include analgesia, broad-spectrum prophylactic antibiotics, tetanus vaccination, and emergent consultation with a hand surgeon. Application of ice, digital nerve block, and local infiltration anesthetic should be avoided due to a theoretical risk of worsening vascular insufficiency.[97] Wide surgical exploration, debridement, and decompression of the affected hand compartments within 6 hours is associated with better outcomes and lower rates of amputation.[96,97] Rapid surgical debridement is paramount.

Compartment Syndrome

Compartment syndrome of the hand is rare, but devastating. There are generally considered to be 10 compartments of the hand: thenar, hypothenar, and adductor; 3 palmar; and 4 dorsal interossei.[98] Diverse mechanisms of compartment syndrome in the hand have been reported, including crush injury, high-pressure injection injury, prolonged immobilization with casting, metacarpal fracture, extravasation of intravenous contrast, burn with eschar formation, and complication of arterial line placement.[99-102]

Clinical suspicion of compartment syndrome should be triggered with a higher-risk mechanism of injury, pain out of proportion to the injury, impaired sensory function, and impaired perfusion. Repeat focused hand examination should be performed, including palpation for tense compartments, eliciting severe tenderness with passive stretching of compartments, detection of impaired sensory function (including 2-point discrimination), and evidence of impaired

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perfusion. The hand is often held in the intrinsic minus position (MCP extension, PIP/DIP flexion).

There is no firm consensus on the compartment pressure at which fasciotomy should be performed. Animal studies demonstrate that compartment pressures > 30 mm Hg lead to irreversible myoneural injury.[103] Assessment of compartment pressure of the hand is technically difficult and operator-dependent, and there is potential for false-negative results, so it is not recommended in the ED.

In cases of very low clinical suspicion, serial examinations are recommended to identify possible early signs of evolving compartment syndrome. Regional nerve block, digital nerve block, and local infiltration are contraindicated, as they increase compartment pressures. Nerve blocks may also blunt findings on serial examination and confound surgical decision-making.

Emergent hand surgery consultation is required for suspected compartment syndrome.

Burns

Fifty percent of major burn victims have significant burn injuries of the hand.[104] After addressing rapidly life-threatening complications, such inhalational injury, and providing appropriate analgesia, the burn should be cleansed with cool water and loose, nonviable tissue removed. Cooling with water that is 10° to 25 °C improves tissue viability up to 30 minutes after the onset of the burn and potentially longer. Cooling with ice water (1°C-8°C) or ice is not recommended and is associated with greater rates of necrosis.[105]

Management of burn blisters is controversial. There is evidence that blisters left intact are associated with faster healing and lower infection rates.[106,107] Topical antibiotics or antibiotic-impregnated semi-occlusive dressings are recommended for second-degree or more-severe burns. The hand should be loosely dressed with sterile dressing in an anatomical position with adequate digital abduction.[106,107]

Care should be individualized for each patient, and early burn specialist consultation is recommended. Excluding very mild superficial burns, all burns of the hand should be considered for consultation with a burn specialist.[108,109]

Controversies And Cutting Edge

Subungual Hematoma: To Remove The Nail Or Not?

Mandatory nail plate removal for subungual hematomas involving > 50% of the nail plate was common practice until relatively recently. This practice habit, endorsed in many textbooks, originated largely from a 1987 retrospective study by Simon et al of 47 consecutive ED patients with subungual hematomas involving > 50% of the nail plate surface area. The authors reported a 60% incidence of nail bed lacerations and a 95% rate of nail bed matrix injury with distal tuft fractures. Due to the high incidence of nail bed matrix injuries, the authors recommended nail plate removal and nail bed matrix repair for subungual hematomas > 50%.[54] Shortly thereafter, Hedges commented that the recommendations made by Simon et al lacked supporting data, and was merely the experiential opinion of the authors. He added, "One can proceed in a prospective manner to compare the outcome of patients whose laceration is repaired versus those whose laceration is left unrepaired under an intact trephined nail."[110]

In 1991, Seaberg et al prospectively enrolled 48 consecutive patients with subungual hematoma with intact nail plates treated with nail trephination alone. The authors reported no instances of nail plate deformity or infection, regardless of subungual hematoma size or presence of underlying distal phalanx tuft fracture.[111] A prospective study of 52 children with subungual hematomas with intact nail plates compared nail plate removal with nail bed matrix repair versus nail trephination alone. The authors reported no differences in nail plate deformities or infection rates between the groups, regardless of hematoma size. The cost was 4 times greater for the nail plate removal and matrix repair group than for the nail trephination group.[56] In addition, the authors also reported no instances of nail plate deformity or infection in the subgroup with uncomplicated distal phalanx fracture undergoing nail trephination alone for subungual hematoma.[56]

Based on the evidence, albeit limited by the size of the aforementioned studies, nail trephination alone appears to be a reasonable practice for subungual hematomas of any size with an intact nail plate.

Lidocaine With Or Without Epinephrine In Digital Nerve Blocks?

Historically, lidocaine with epinephrine has been avoided in digital nerve blocks due to the perceived risk of ischemia. The fear stems largely from very old case reports of digital ischemia associated with cocaine or procaine with epinephrine.[112-117] In 2005, Lalonde et al published a prospective nonrandomized study of 3110 consecutive patients who underwent local infiltration or digital nerve block with lidocaine and 1:100,000 epinephrine. The authors reported no cases of digital ischemia.[118] In 2001, Wilhelmi et al reported no cases of digital ischemia in a double-blinded randomized controlled trial of 60 patients undergoing digital nerve block using lidocaine with epinephrine versus lidocaine without epinephrine.[119] Several case reports of accidental epinephrine injection by autoinjector pens into the digits (at 5-10 times the typical dose used in local anesthesia) resulted in no clinically significant adverse outcomes.[120-122]

Based on the current evidence, the use of lidocaine with epinephrine appears to be a safe practice

in patients without risk factors for digital ischemia. In patients already at risk of digital ischemia (eg, peripheral vascular disease, Buerger disease, scleroderma, or compartment syndrome) we do not recommend using lidocaine with epinephrine in the hand. Lidocaine or bupivacaine without epinephrine and application of a glove ring tourniquet is a reasonable practice.

Disposition

The majority of patients with acute injuries to the hand receive definitive care in the ED. Indications for hospital admission include a need for emergent operative intervention or clinical observation (eg, serial examination in patients with suspected risk of compartment syndrome). Many patients will require outpatient referral to a hand surgeon, although a subset of low-risk injuries are appropriate for primary care referral, such as simple lacerations, sprains, and strains.

Summary

The hands are elegant anatomical structures that play a pivotal role in our daily lives within our family, work, and recreational environments. Best patient care and clinical decision-making rests largely upon anatomical knowledge, physical examination, and recognition of the limitations of imaging modalities. Although injuries to these structures are infrequently life-threatening, they are commonly seen in the ED, and are associated with significant patient morbidity and physician medicolegal risk. Respect for the critical role of the hand in everyday life supports a diligent ED clinical evaluation and a low threshold for referral to a hand surgeon.

Case Conclusions

Radiographs of your first patient with suspected flexor tendon injury revealed no fracture or retained foreign body. Examination demonstrated an inability to flex the fifth digit at the PIP or DIP joints. A digital ring tourniquet was placed, and you directly visualized the distal transected stumps of the fifth FDS and FDP tendons. You discussed the case with the hand surgeon on call and obtained outpatient follow-up for delayed flexor tendon repair within 7 days. You gave the patient Tdap IM, the skin laceration was approximated with nonabsorbable simple interrupted sutures, an ulnar gutter splint was placed in the intrinsic plus position, and you prescribed a prophylactic antibiotic, cephalexin. You discharged the patient with follow-up instructions for the hand surgeon.

For your second case, despite your calm verbal encouragement, hospital security personnel had to physically restrain the intoxicated patient to prevent him from leaving the ED. Physical examination revealed a 5-mm puncture wound over the fourth metacarpal joint of his

Time- and Cost-Effective Strategies For Acute Hand Injuries

1. **Avoid unnecessary prophylactic antibiotics in low-risk hand lacerations.**
   Risk management caveat: Level I evidence exists demonstrating no improvement in wound infection rates with prophylactic antibiotics in low-risk lacerations. Immunocompromised patients, human or animal bites, puncture wounds, penetrating tendon injury, crush injury, gross contamination, and open fractures (except tuft fracture) are associated with a higher risk of infection. The decision to prescribe prophylactic antibiotics should be made on a case-by-case basis

2. **Consider outpatient hand surgeon referral for MRI for gamekeeper's thumb with an equivocal examination.**
   Risk management caveat: The diagnosis of gamekeeper's thumb may be difficult to make on clinical grounds alone. In suspected gamekeeper's thumb, splint and refer. MRI in the outpatient setting may be helpful in establishing the diagnosis in difficult cases.

3. **Nail plate removal is not indicated for subungual hematomas if there is no nail plate disruption.**
   Risk management caveat: Level II evidence in adults and pediatric patients reports low rates of complications with trephination alone for treatment of subungual hematoma, of any size, without nail plate disruption.

4. **In high-pressure injection injury, surgical intervention within 6 hours decreases the functional disability and risk of amputation.**
   Risk management caveat: Wide surgical exploration, debridement, and decompression of the affected hand compartments within 6 hours is associated with better functional outcomes and decreased rates of amputation. High-pressure injection injury is a true surgical emergency of the hand. Emergent consultation with a hand surgeon is critical.

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right hand, and you performed wound care and wound exploration. There was no evidence of extensor tendon transection; however, the wound overlaid the MCP joint space, and you detected a breach in the joint capsule while his hand was held in a clenched-fist position. You made the patient NPO and gave him a prophylactic antibiotic, amoxicillin/clavulanate. Radiographs revealed no fracture or retained foreign body. You consulted the hand surgeon on call for admission for operative exploration of the fight bite injury with joint violation.

When your third patient, who was involved in the motor vehicle crash, came back from the CT scanner, you noted that the study demonstrated a small subdural hematoma. She remains confused, with a GCS score of 14. There was no evidence of coagulopathy. The neurosurgeon on call was on his way. You re-evaluated the first MCP joint on her left hand. You appreciated 40° of forced radial deviation of the thumb MCP joint in mild flexion, although the unaffected side had no significant UCL ligamentous laxity. Three-view thumb radiographs revealed no fracture or dislocation. You placed the patient in a thumb spica splint and notified the admitting team of the need for hand surgeon referral.

Abbreviation List

CMC	Carpometacarpal joint
DIP	Distal interphalangeal joint
FDP	Flexor digitorum profundus
FDS	Flexor digitorum superficialis
FOOSH	Fall on outstretched hand
FPL	Flexor pollicis longus
IP	Interphalangeal joint
MCP	Metacarpophalangeal joint
NSAID	Nonsteroidal anti-inflammatory drug
PIP	Proximal interphalangeal joint
UCL	Ulnar collateral ligament

References

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 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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Risk Management Pitfalls For Hand Injuries (Continued on page 23)

1. "The patient with a laceration overlying a joint was unable to move the joint through full range of motion due to pain during wound exploration, but I did not see any evidence of tendon injury."
Complete examination through full range of motion is required to assess for tendon injury because the injured tendon may be retracted in the neutral position. Regional nerve block or digital nerve block is often necessary to permit full range of motion during wound exploration. If diagnostic uncertainty persists, splint and refer.

2. "The patient seemed to be in a lot of pain following the crush injury. I repeated multiple doses of opioid analgesia at appropriate dosages, but the patient continued to complain of worsening pain and then she subsequently complained of numbness and tingling."
Pain out of proportion to the injury is an early clinical sign of possible compartment syndrome. Repeat focused hand examination should include palpation for tense, swollen hand compartments, eliciting severe tenderness on passive stretching of compartments, finding impaired sensory function (including 2-point discrimination), and looking for evidence of impaired perfusion. Emergent consultation with hand surgery is critical.

3. "I gave cefoxitin for an acute, clean, open distal tuft fracture and consulted a hand surgeon for operative wash-out, intravenous antibiotics, and admission."
Parenteral antibiotics are not indicated for low-risk open distal tuft fractures. Patients require analgesia, meticulous wound care, reduction, splinting, and referral to a hand surgeon.

4. "In a patient with mallet finger, I buddy-taped the affected digit to the adjacent digit to immobilize it."
Mallet finger requires limited splinting of the DIP alone, in extension, for 6 to 8 weeks and referral to a hand surgeon.

5. "A patient with wrist pain after a FOOSH injury had point tenderness over the lunate and severely impaired wrist range of motion. No anatomical snuffbox tenderness was noted. Anterior-posterior, lateral, oblique, and navicular view radiographs showed 2-mm scapholunate diastasis. Since no fracture was present on radiographs, I diagnosed the patient with a wrist sprain. The patient was discharged home with rest, ice, compression wrap, NSAIDs and primary care follow-up."
Patients with suspected scapholunate instability require thumb spica splinting and outpatient referral to hand surgery.

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Risk Management Pitfalls For Hand Injuries (Continued from page 22)

6. **"I could not stop the bleeding with direct pressure, so I placed a figure-of-eight suture."** Figure-of-eight suture, or blind clamping of bleeding vessels, should be avoided due to possible injury to adjacent structures. Hemorrhage control should be managed with focal direct pressure and limb elevation. Temporary tourniquet placement should be considered if significant bleeding persists.

7. **"A patient with high-pressure injection injury of an unknown substance had no symptoms. Following routine wound care and tetatnus vaccination, I discharged him home with a referral to primary care."** Early high-pressure injection injury often appears clinically innocuous. The injected material tracks along neurovascular bundles along the path of least resistance. These injuries are associated with a high rate of infection, necrosis, and considerable amputation risk. All patients should receive intravenous antibiotics and immediate hand surgery consultation for operating room wound exploration and admission.

8. **"My patient had a fifth metacarpal neck fracture on the dominant hand with an overlying laceration. I gave him cefoxitin for the open fracture and called hand surgery to admit him."** Lacerations overlying the MCP joints or distal metacarpal should be considered a fight bite injury until proven otherwise. Amoxicillin-clavulanate is an appropriate choice for prophylaxis.

9. **"The patient presented with a grossly contaminated laceration overlying the hypothenar eminence. Wound exploration revealed no complicating soft-tissue injuries. Tissue debridement was required to remove organic plant debris. Radiography did not reveal retained foreign body or fracture. I closed the laceration with simple interrupted sutures and the patient was instructed to see his primary care doctor in 14 days for suture removal."** Wounds at moderate to high risk of infection should receive prophylactic antibiotics. Primary closure is not recommended. High-risk wounds may be considered for delayed primary closure.

10. **"Despite multiple attempts, I was unable to reduce a fourth proximal phalanx oblique shaft fracture, and 15° of rotational deformity and 20° of angulation persists. I buddy-taped the affected digit and discharged the patient with instructions to follow up with a hand surgeon."** Inability to achieve reduction goals (in this case, 0° rotational deformity and < 10° angulation) requires immediate hand surgery consultation for closed reduction or possible open reduction. This patient should also have been placed in an ulnar gutter splint and not buddy-taped.

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1. Which of the following describes the appropriate storage method for an amputated part?
- a. Amputated part placed in a bag with ice and water
- b. Amputated part wrapped in moist gauze in bag, then placed into a second bag containing ice
- c. Amputated part wrapped in moist gauze placed in bag with ice
- d. Amputated part placed in an empty bag, that bag placed into a second bag containing ice

2. What clinical criteria are consistent with a diagnosis of gamekeeper's thumb?
- a. 5° joint laxity, thumb MCP joint with radial stress
- b. Puncture wound
- c. Pallor
- d. > 30° joint laxity, thumb MCP joint with radial stress

3. Which of the following is the correct method of physical examination of the median nerve in the hand?
- a. Light touch fifth fingertip; resistance against finger abduction
- b. Light touch second fingertip; resistance against thumb adduction
- c. Light touch second fingertip; resistance against thumb opposition
- d. Light touch dorsal aspect thumb carpal-metacarpal joint; resistance against wrist extension

4. What is the recommended method of hemorrhage control in persistent hemorrhage from a radial artery injury despite direct pressure and limb elevation?
- a. Proximal tourniquet placement
- b. Placement of a figure-of-eight suture of bleeding vessel
- c. Local injection of epinephrine
- d. Clamping visibly bleeding arteriole

5. Which of the following regarding appropriate wound care is FALSE?
- a. A 35-cc syringe with a 18-gauge catheter will deliver irrigant at an appropriate pressure.
- b. Irrigation with potable tap water is noninferior to sterile normal saline.
- c. The optimal volume of irrigant is not known.
- d. Prophylactic antibiotics have been shown to decrease infection rates in superficial hand lacerations.

6. Which of the following is the most common site of a fight bite wound?
- a. Dominant hand, fifth MCP joint
- b. Nondominant hand, third MCP joint
- c. Dominant hand, third MCP joint
- d. Nondominant hand, fourth MCP joint

7. According to the most recent literature, which of the following is an indication for nail plate removal and exploration for nail bed matrix injury?
- a. Stellate nail plate disruption
- b. Nondisplaced tuft fracture
- c. Hematoma > 50% of the surface area of the nail plate
- d. Hematoma > 25% of the surface area of the nail plate

8. What is the most appropriate splint for mallet finger?
- a. Splint entire digit mild DIP flexion
- b. Splint spanning middle and distal phalanx, in mild DIP extension
- c. Splint spanning middle and distal phalanx, in mild DIP flexion
- d. Splint entire digit, in DIP extension

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9. **Which of the following is NOT an indication for urgent hand surgery consultation in boxer's fracture?**
   a. Postreduction, there is 5° rotational deformity fifth digit
   b. Puncture wound overlying fifth MCP joint
   c. 3 days following injury, presence of tense swelling, pain out of proportion, and paresthesias, extending into the proximal hand
   d. Postreduction there is 30° angulation fifth metacarpal

10. **Which of the following describes the best method to reduce a Bennett fracture?**
   a. Axial traction and valgus pressure
   b. Axial traction and varus pressure
   c. Axial traction, thumb opposition, and radial pressure over the metacarpal base
   d. Axial traction, thumb adduction, and ulnar pressure over the metacarpal base

In upcoming issues of *Emergency Medicine Practice*

- Allergy And Anaphylaxis
- Ankle And Foot Injuries
- Geriatric Trauma
- Hypertension In The ED
- Alcohol Withdrawal
- Upper Gastrointestinal Bleeding
- Deep Vein Thrombosis

Next month in *Emergency Medicine Practice*

Seizures And Status Epilepticus: Diagnosis And Management In The Emergency Department

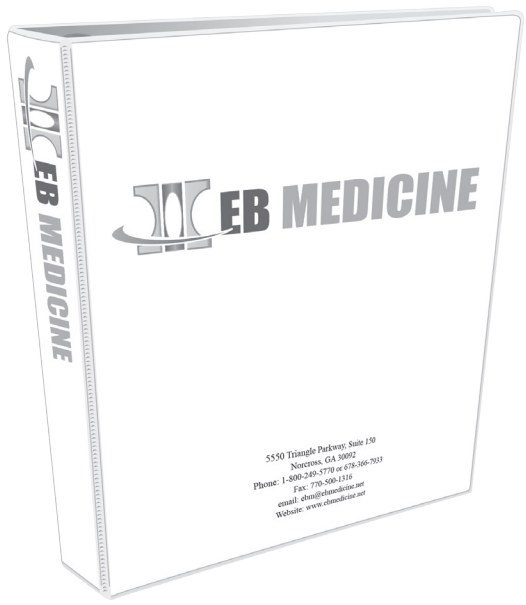
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Seizures account for 1% of all emergency department visits in the United States, and for 41% of the cases, the etiology is unknown. For the emergency clinician who is treating a patient suspected of having had a seizure, the first step is to differentiate a true seizure from conditions that mimic them. Often, seizing patients have minimal reliable history to guide treatment, and the patients are often unable to cooperate in the initial examination.

This issue of *Emergency Medicine Practice* reviews the best evidence on recognizing, differentiating, and treating seizures and status epilepticus in the emergency department, with special attention given to the recent RAMPART trial on optimal administration of benzodiazepines, the first-line therapy for seizing patients. Other pharmacologic therapies are also reviewed, along with recommendations for disposition and follow-up for these patients.



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