

Non-operative treatment of common finger injuries

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Abstract Finger fractures are common injuries with a wide spectrum of presentation. Although a vast majority of these injuries may be treated non-operatively with gentle reduction, appropriate splinting, and careful follow-up, health care providers must recognize injury patterns that require more specialized care. Injuries involving unstable fracture patterns, intra-articular extension, or tendon function tend to have suboptimal outcomes with non-operative treatment. Other injuries including terminal extensor tendon injuries (mallet finger), stable non-articular fractures, and distal phalanx tuft fractures are readily treated by conservative means, and in general do quite well. Appropriate understanding of finger fracture patterns, treatment modalities, and injuries requiring referral is critical for optimal patient outcomes.

Keywords Finger fracture · Non-operative treatment · Mallet finger · Tuft fracture · Boxer's fracture

Introduction

Bone and joint injuries of the hand are common. While often viewed as trivial injuries, a poorly treated finger fracture can have significant functional consequences. These injuries may result in chronic pain, stiffness, and deformity; preventing patients from participating in

activities of daily living. It is not uncommon for stable fractures to be over treated and unstable fractures to be neglected, both potentially resulting in permanent disability. Accurate diagnosis and timely management of these injuries continues to be the cornerstone of optimal hand care.

General principles of treatment

The goal of treatment for any finger injury is to restore the normal function of the finger. Restoration of bony anatomy is the basis for returning normal function; however, an anatomic reduction is not always necessary to achieve this goal, especially if it comes at the cost of soft tissue scarring and loss of motion. To initiate early hand motion, fracture stability must be present either through the inherent stability of the fracture, splinting, or internal fixation. Early motion prevents adhesions of the gliding soft tissues of the extensor and flexor tendon systems and prevents contracture of the joint capsules. Immobilization of fingers much beyond 4 weeks will lead to long-term stiffness due to extensor tendon and joint capsular scarring. For example, non-articular phalangeal fractures treated with closed reduction and splinting are mobilized after 3–4 weeks, once the fractured phalanx is less tender. Even if splinting of one joint is needed, splints should be made small enough to allow early motion of uninjured joints.

Closed non-displaced or minimally displaced fractures with acceptable alignment that are the result of a low-energy trauma usually have sufficient supporting tissues remaining intact making them stable and amenable to treatment by protected mobilization, either with local splinting of the fracture or buddy taping to adjacent fingers.

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Fractures with rotational or angular malalignment may be amenable to closed reduction and splinting, but these fractures are at risk for incomplete reduction and recurrent deformity. These more unstable fractures require careful and frequent clinical and radiographic follow-up. Surgical treatment is indicated for any fractures of the articular surface, open fractures, fractures with significant shortening or malrotation, and fractures which fail closed reduction. Delayed treatment of these surgically indicated fractures is always more difficult, with worse functional outcomes due to stiffness, incomplete deformity correction, and post-traumatic arthritis.

Diagnosis

The signs of injury are usually obvious: pain, swelling, tenderness, ecchymosis, deformity, and/or skin abrasions. The differential diagnosis for finger injuries includes fracture, collateral ligament rupture, and tendon laceration or avulsion. A careful examination of the flexor tendons, extensor tendons, and neurovascular function must be documented.

At a minimum, three x-ray views of the injured hand must be obtained with the imaging beam centered over the metacarpophalangeal (MCP) joint of the long finger. The posterior–anterior (PA), lateral, and oblique views screen for trauma. PA and lateral views of the injured digit centered on the PIP joint should be obtained when a particular digit is of concern.

Principles of closed treatment

Closed reduction may be performed via axial traction followed by reversal of the deformity. For digital fractures, the intrinsic muscles can be relaxed by flexion of the MCP joints. Once the reduction is performed, the digit is examined to determine the stability of the reduction. Rotational alignment is checked by active finger flexion, observing the planes of the nail beds, and assessing for digital overlap. The fingers should all point toward the scaphoid tubercle (Fig. 1). If pain prevents active flexion, use of tenodesis with gentle wrist extension can result in digital flexion.

A radial or ulnar gutter type splint with the MCP joints flexed as close to 90° as possible will hold the digits aligned while relaxing the intrinsics and preventing collateral ligament contracture. Although splinting at 90° of MCP flexion is preferable, as little as 60° of MCP flexion is likely adequate to place the collateral ligaments on maximal strain, and may be easier to achieve. In the case of a stable non-displaced fracture, “buddy taping” the injured digit to an adjacent uninjured digit may be adequate.

Post-reduction x-rays should be obtained in two planes. Analysis of sagittal alignment on the lateral view is often difficult, particularly in plaster, and a series of oblique radiographs may be needed to confirm that correct alignment has been achieved. Follow-up 1 week after initial reduction with new radiographs is required to confirm the maintenance of alignment. Delay of follow-up beyond 1 week can make salvage of a lost reduction more difficult.

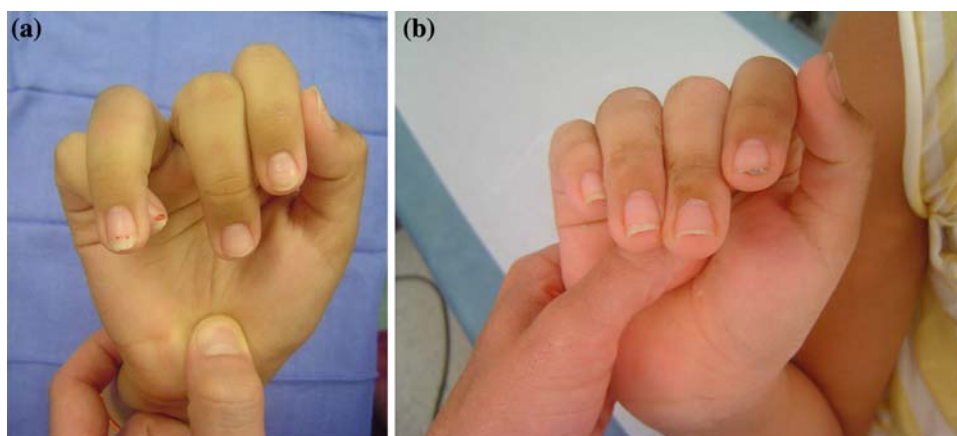
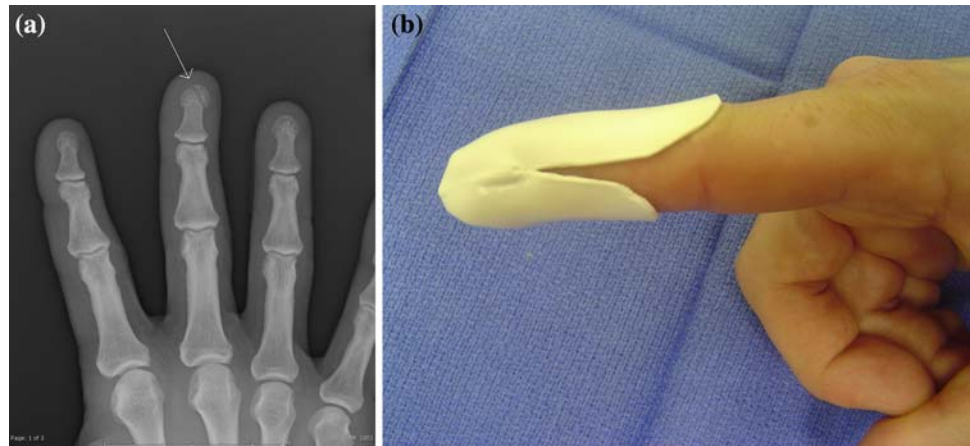


Fig. 1 (a) This image shows a rotational malalignment of the ring finger (crossing over the small finger) from a fracture at the base of the proximal phalanx of the ring finger. Due to a fairly normal looking appearance of the hand with the fingers extended the injury was initially treated non-operatively. Notice the gap between the middle and ring fingers, and the deviation of the ring finger from the normal

cascade. The patient was treated with an operative reduction and percutaneous pinning. (b) A normal finger cascade with all fingers pointing toward the thenar eminence is seen in the same patient 4 weeks after surgery. Passive finger flexion is demonstrated using the tenodesis effect that occurs with passive wrist extension

Fig. 2 (a) AP radiograph showing a distal tuft fracture (arrow) (b) Typical clamshell splint used to protect a tuft fracture



Specific injury patterns

Distal tuft fractures

The most common hand fractures are of the distal phalanx as it extends most distally during hand use, especially in the thumb, index, and middle fingers. Since there are few deforming forces about the distal phalanx, these fractures can usually be treated in a closed manner with simple splinting, closed reduction and splinting, or closed reduction and percutaneous fixation.

Tuft fractures can be treated with immobilization using a clam-shell type splint, while unstable transverse shaft fractures are ideally managed with operative fixation consisting of a longitudinal Kirschner wire or screw [1]. Regardless of the treatment selected for the underlying bony injury, the commonly associated soft tissue and nail bed injury cannot be ignored. Many of these are open injuries that require adherence to the principles of treatment of open fractures including: a course of antibiotic therapy along with a thorough debridement of any devitalized tissue. Nail bed injuries should be treated with subungual hematoma decompression and re-approximation of nail bed lacerations with fine absorbable sutures (e.g., 5–0 suture). One may ensure the proximal nail fold remains open by avoiding injury to this structure and by placing a temporary spacer in situations requiring complete removal of the native nail plate [2].

Most tuft fractures can be protected by 2–3 weeks of simple splinting including the DIP joint, but leaving the PIP free (Fig. 2). Motion of the DIP is begun at 2–3 weeks, with continued protection during active use until pain resolves. Due to the injury to the finger tip, which is the terminal sensory organ, patients must be warned that they will often have decreased function caused by hyperaesthesia, cold intolerance, and numbness even 6 months after the injury [1]. A fibrous non-union of the fracture may result, usually with limited functional consequences.

Mallet fractures

The majority of distal phalangeal base fractures are “mallet injuries”, occurring due to an axial load with a resultant disruption of the terminal extensor mechanism. Mallet injuries with and without a bony fragment may be effectively treated by splinting the DIP joint in extension for 8 wks, followed by 1 month of night splinting [3]. Splinting using a dorsal, volar, or pre-fabricated Stack type splint are all reasonable treatment methods (Fig. 3). Care must be taken to avoid dorsal skin ischemia and potential

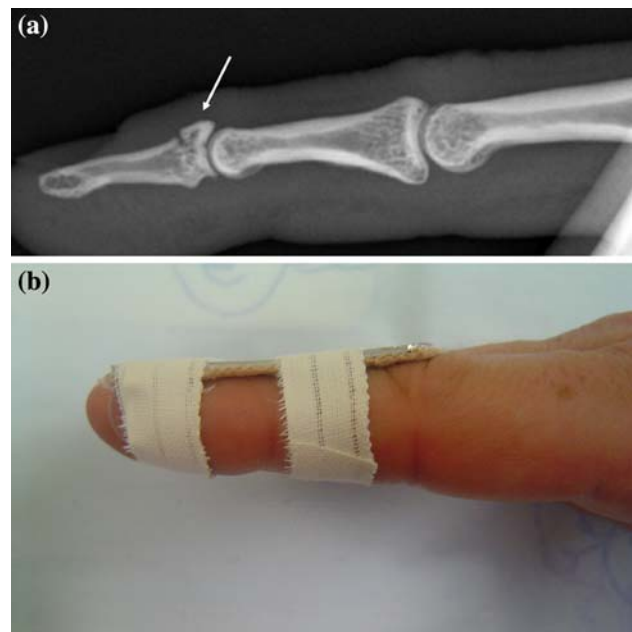


Fig. 3 (a) Lateral radiograph of a mallet fracture (b) Dorsal splint used for mallet finger (soft tissue or bony mallet). Notice slight extension pre-bent into splint to assist in reduction of the avulsed fracture fragment seen in Fig. 3a. Patients treated with dorsal splints should be examined frequently for dorsal skin breakdown under the splint

breakdown seen in cases of splinting the DIP joint in a hyperextended position.

When a bone fragment has been retained with the extensor tendon, the opportunity to heal is enhanced because of the greater healing potential of bone compared to tendon, but x-rays must be taken in the splint to ensure a concentric joint has been maintained. The PIP should be left free, as immobilization of the PIP joint and its resultant stiffness may cause more morbidity than the original injury. Patients are counseled to expect a slight extensor lag ($5\text{--}10^\circ$) under the best circumstances, with a mild loss of total motion. If after splinting there is $>20^\circ$ of recurrent mallet deformity, the splinting program is re-instituted for an additional month or two. Chronic mallet injuries do well with splinting as late as 3 months [4].

Internal fixation of mallet fingers is recommended in cases of volar subluxation of the distal phalanx or in cases where the dorsal component is greater than one-third of the joint surface [5]. Open reduction has a significant risk of complications, so percutaneous internal fixation using Kirschner wires for reduction and fixation is the preferred technique if possible. A variety of wire configurations have been shown to be safe and effective, as long as a congruent reduction of the DIP joint is confirmed on the lateral x-ray [5, 6].

Shaft fractures of the middle and proximal phalanges

Treatment of closed extra-articular fractures of the proximal and middle phalanges can be guided first by separating these injuries into non-displaced and displaced fractures. Most non-displaced extra-articular fractures can be treated with buddy-taping and early motion for 3–4 weeks. For displaced fractures one must carefully consider their stability following closed reduction. As for spiral fractures or others with potential for instability, splinting may be attempted; however, vigilant follow-up is a must to watch for any subsequent displacement (Fig. 4).

Displaced fractures may be unstable, even if reduced, and can be difficult to hold reduced. Among shaft fractures oblique, spiral, or comminuted fractures tend to be unstable, while transverse fractures in adults or Salter II metaphyseal fractures in children tend to be stable once reduced. A common transverse fracture in adults occurs at the base of the proximal phalanx. The pull of both intrinsic and extrinsic muscles extends the finger, causing an apex volar, extension type deformity at the fracture site. Fractures of the middle phalanx distal to the insertion of the flexor superficialis (FDS) tendon will deform in a similar manner, while fractures proximal to the insertion of this tendon will deform with an apex dorsal angulation.



Fig. 4 AP radiograph of a long oblique fracture of the proximal phalanx. The inherent instability of the fracture pattern will lead to suboptimal finger function if treated non-operatively

Metacarpal fractures

Just as with fractures of the phalanges, stable, minimally displaced fractures of the metacarpals can usually be treated with simple closed reduction and splinting. The intermetacarpal ligaments are stout ligaments that span between each metacarpal head and resist displacement of low-energy fractures. The most frequent fracture of the hand is a fracture of the small finger metacarpal neck, the so-called “boxer’s fracture” (Fig. 5).

Traditional teaching allows for conservative management of metacarpal neck fractures with the following degree of apex dorsal angulation: small finger: $40\text{--}50^\circ$, ring finger: 30° , middle finger: 20° , index finger: 10° . The degree of apex dorsal or volar angulation at the fracture site is more accurately assessed with a lateral radiograph of the hand. Oblique views have been shown in a cadaveric study to be misleading, often amplifying the actual angle of the fracture [7]. Apex dorsal angulation, if left unreduced will lead to a change in the appearance of the cascade of MCP joints on the dorsum of the hand. A recent retrospective review evaluated three different casting techniques for closed management of extra-articular metacarpal fractures: one group was casted with the MCP joint in flexion with full interphalangeal (IP) joint motion permitted, another



Fig. 5 Lateral radiograph of a boxer's fracture (arrow)

group was casted with the MCP joint in extension and full IP joint motion permitted, and the last group was casted with the MCP joint flexed and the IP joints extended without motion. The authors found no differences between groups in terms of maintenance of fracture reduction, finger range of motion, or grip strength [8].

Certainly these deformities are only acceptable if there is no significant rotational deformity (any rotation of $>5^\circ$). Small finger rotation should be carefully assessed as fracture site swelling within the fourth web space can exaggerate a perceived rotational deformity. In addition, recent literature has demonstrated with cadaveric testing that metacarpal shortening of up to 1 cm may lead to nearly 50% of decreased grip strength [9]. A bothersome post-operative problem of operative treatment for any metacarpal fracture by closed reduction and percutaneous pinning or open reduction and internal fixation is adhesions of overlying extensor tendons. In order to minimize the impact of extensor tendon adhesions, sufficient fixation should be achieved to allow for early digital motion.

Surgical indications

Correct recognition of finger injuries that require operative intervention for optimal outcome is as important as proper treatment of stable finger fractures to maintain function. Attempted non-operative treatment of these injuries will result in the delay of appropriate care, which in most instances will negatively affect the ultimate outcome (Fig. 1).

Persistent rotational deformity after finger fracture will result in poor esthetic and functional outcomes. Fractures at risk for this deformity include oblique and spiral fractures and fractures with comminution preventing bony interdigitation of the fracture fragments. As described above, diligent assessment of the rotational profile of any injured finger is of utmost importance to avoid this difficult deformity.

Injuries of the finger involving the flexor tendons are also injuries that require early operative intervention for optimal outcome. The so-called "jersey finger" is an avulsion of the distal insertion of the flexor digitorum profundus (FDP) tendon from the volar aspect of the distal phalanx. A spectrum of these injuries exists from avulsion of the FDP tendon with minimal retraction, to an avulsion fracture of the tendon insertion site, to dorsal subluxation of the distal phalanx after the avulsion injury. Due to the need for stable anatomic reduction and fixation, as well as the need for early supervised physical therapy to avoid long-term stiffness, these injuries must be referred to a hand specialist as soon as they are diagnosed or even suspected [5].

Finally, intra-articular injuries involving the IP joints and the MCP joints are known to be associated with residual stiffness, often leading to long-term function deficits of the injured joint. Similar to most intra-articular fractures, these injuries require anatomic reduction, rigid fixation, and early range of motion. Appropriate triage and referral for management of these complex fractures is paramount for acceptable long-term outcome.

Summary

Fractures of the phalanges and metacarpals are common injuries. The initial evaluation of these injuries requires quality radiographs to define the injury and determine an appropriate treatment plan: non-operative versus operative. Stable fractures without rotational deformity or intra-articular extension are best treated non-operatively with gentle reduction, appropriate splinting, and early motion to provide an environment for fracture healing without excessive residual stiffness. Tuft fractures, mallet fingers, and boxer's fractures are examples of commonly seen

injuries that are readily treated with careful non-operative treatment. Fractures that cannot be managed conservatively, including those with residual deformity, intra-articular extension, or tendon injury, are best handled with referral to a hand specialist for appropriate early management.

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