Fractures and Dislocations

36

Subhas Gupta and Amir Arsalan

Fractures

To serve as a reference, we have created a treatment algorithm for phalangeal and metacarpal fractures. Refer to the figures noted as you follow the text.

Phalangeal (Fig. 36.1)

Distal Phalanx

Tuft fractures usually occur secondary to crush mechanism and are typically associated with soft tissue injury. Subungual hematomas that involve >50% of the nail plate are often suggestive of nailbed injury and should warrant nailbed exploration, whereas those <50% can be managed conservatively with or without trephination [1].

Shaft fractures of the distal phalanx are considered stable due to the support provided by the nail plate dorsally and fibrous septae volarly. Although these structures serve as an internal splint, one may also use an external splint. Percutaneous pinning is another option for displaced shaft fractures [2].

Fractures at the base of the distal phalanx should trigger concern for tendon injury. An avulsion fracture at the dorsal base may represent injury to the extensor tendon insertion. This condition is known as "mallet finger," and patients will often present with extensor lag. Conservative treatment consists of continuous extension splinting for at least 8 weeks. Operative management, such as extension block pinning or suture button, may also be considered [3].

Middle and Proximal Phalanx

Non-articular fractures of the middle and proximal phalanges must be evaluated for stability. Nondisplaced and stable fractures can be managed conservatively with splinting for 3 weeks. Malrotation, angulation, or comminution are indications for operative management—open reduction internal fixation (ORIF) versus closed reduction percutaneous pinning (CRPP). Unstable fractures such as oblique, spiral, or transverse are unlikely to maintain reduction with closed treatment and have the potential for rotation or angulation. These are also managed operatively.

Non-articular base fractures usually present with apex volar angulation due to the vector of pull created by interossei attachments. Any

Supplementary Information The online version of this chapter (https://doi.org/10.1007/978-3-030-78028-9_36) contains supplementary material, which is available to authorized users. The videos can be accessed by scanning the related images with the SN More Media App.

S. Gupta (✉) · A. Arsalan
Department of Plastic and Reconstructive Surgery,
Loma Linda University Health,
Loma Linda, CA, USA
e-mail: SGupta@llu.edu

S. R. Thaller, Z. J. Panthaki (eds.), *Tips and Tricks in Plastic Surgery*,
https://doi.org/10.1007/978-3-030-78028-9_36

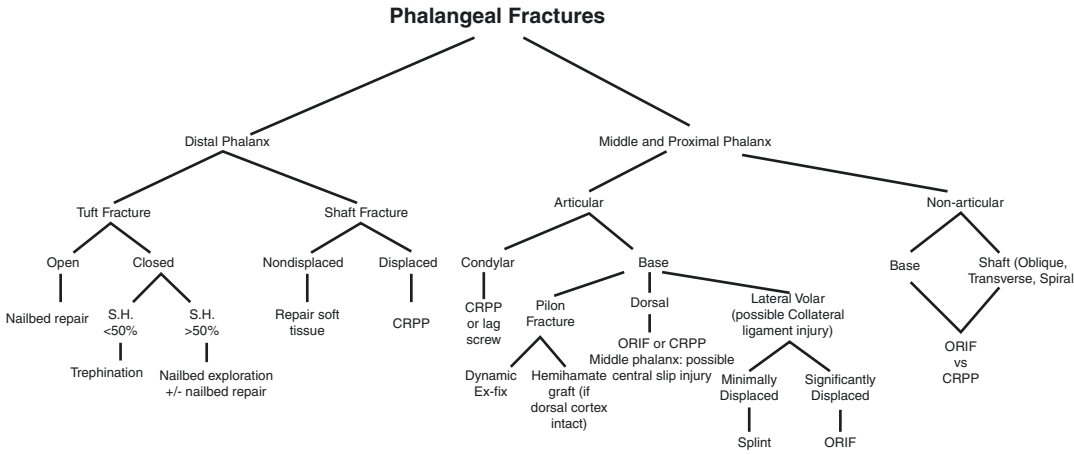

Fig. 36.1 Phalangeal fractures. SH subungual hematoma, CRPP closed reduction percutaneous pinning, ORIF open reduction internal fixation

angulation greater than 25 degrees in the adult patient is unacceptable, as this leads to a significant loss of motion and reduced function. Closed reduction with immobilization is recommended if the reduction remains stable; otherwise, operative interventions will be necessary. Chronic injuries require osteotomies to correct residual angulation [1].

Articular fractures are unlikely to do well with conservative treatment, as the likelihood of developing stiffness is high. The primary goal is to restore the gliding surface of the joint. Condylar fractures can be addressed with CRPP or ORIF with lag screw technique. Percutaneous pinning with single K-wire is often inadequate, and multiple treatments may be necessary.

Pilon fractures can result from axial load injuries. In the acute period, they can be managed with dynamic external fixation. The advantage of this technique is the potential for early motion. If the dorsal cortex is intact, a hemihamate osteoarticular graft is another option. The main disadvantages are additional donor site morbidity and relative difficulty in application [4].

Dorsal base fractures of the middle phalanx present unique challenges related to injury to the central tendon insertion. The tendon insertion site must be restored in addition to fracture stabilization. Displacement greater than 2 mm of the avulsed fragment is poorly tolerated and can lead to extensor lag and eventually boutonniere deformity [1]. As such, it is crucial to obtain accurate reduction with either ORIF or CRPP.

Metacarpal (Fig. 36.2)

Head

Although metacarpal head fractures are rare, they usually have intraarticular involvement. In addition to a standard three-view X-ray, a special Brewerton view will provide a much more detailed look at the articular contour. Careful evaluation of the soft tissue should always be performed, as any lacerations or wounds overlying the dorsal metacarpophalangeal (MP) joint is a "fight bite" until proven otherwise. These wounds are presumed to have oral contamination and will require thorough irrigation and debridement [5].

Comminution presents technical challenges during surgery. If operative management is not feasible, then the fracture can be immobilized with the MP joint at 70 degrees. Prosthetic arthroplasty is an option in the setting of bone loss; however, this should not be performed for the index finger, given high rates of implant failure from shear stress during pinch [1]. All patients should be counseled about stiffness and the potential need for secondary operations such as tenolysis and capsulotomy.

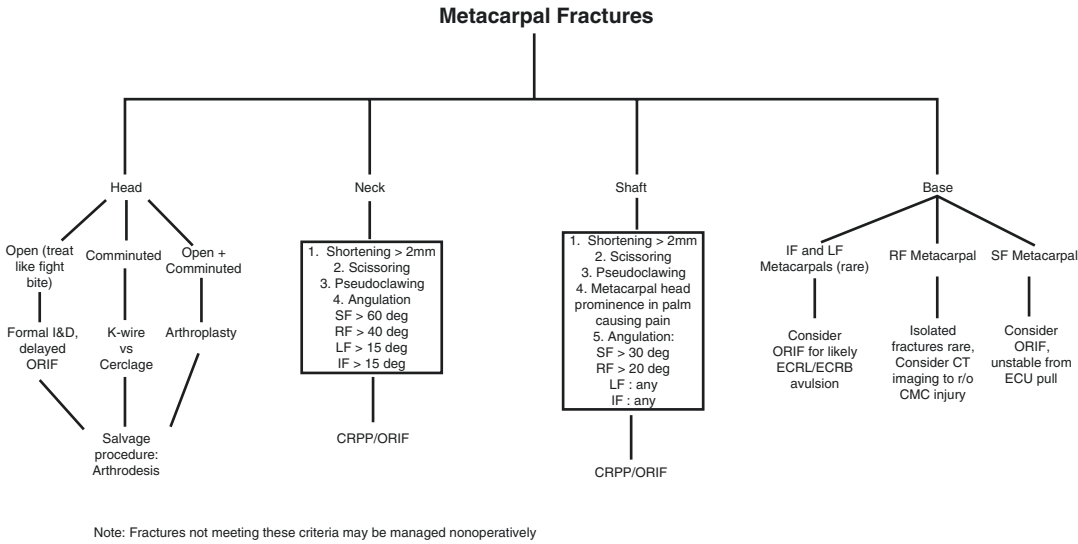

Fig. 36.2 Metacarpal fractures. CRPP closed reduction percutaneous pinning, ORIF open reduction internal fixation. Note: Fractures not meeting these criteria may be managed nonoperatively

Neck

Metacarpal neck fractures often present with apex dorsal angulation, given the relationship of the intrinsic muscles to the MP joint. Optimal management of these fractures remains controversial, but important factors to consider include shortening, rotational deformity, and the degree of angulation [6]. The small and ring fingers have relatively mobile carpometacarpal (CMC) joints compared to the index and long, and therefore are more forgiving for any residual angulation. The small and ring fingers can tolerate 50–60 degrees and 30–40 degrees, respectively, whereas anything greater than 15 degrees of angulation for the index and long fingers is generally unacceptable [7]. Compensatory MP joint hyperextension and proximal interphalangeal (PIP) joint flexion during attempted extension, also known as pseudo-clawing, is another indication for operative management [8].

Shaft

Similar to its phalangeal counterpart, metacarpal shaft fractures can be characterized as transverse, oblique/spiral, or comminuted. Management is also similar. Transverse and comminuted fractures result from axial loading. Oblique and spiral fractures should be carefully examined for malrotation. Angulation is not as well tolerated in the metacarpal shaft compared to the head. The small and ring fingers can tolerate 30–40 degrees and 20–30 degrees, respectively. Anything greater than 10 degrees for index and long fingers is unacceptable. Fixation options include K-wire, plates and screws, or lag screws alone [9].

Base

Isolated fractures of the index and long finger metacarpal base are rare, as the corresponding CMC joints are relatively immobile. These fractures can be associated with extensor carpi radialis longus (ECRL) and extensor carpi radialis brevis (ECRB) injury [10]. Nonoperative management is reasonable; however, if injured, ECRL and ECRB insertion should be restored. It is our preference to use a bone anchor in this situation.

Thumb

Because of its relatively mobile CMC joint, extra-articular thumb fractures are forgiving.

Thumb phalangeal fracture management follows similar principles used for finger phalangeal fractures. Special considerations include fracture–dislocations of the ulnar base of the proximal phalanx, which typically represents an ulnar collateral ligament (UCL) injury. This is referred to as a skier's thumb for acute injuries or gamekeeper's thumb when chronic. Treatment consists of ORIF and immobilization for 4 weeks. A Stener lesion can occur if the adductor pollicis muscle becomes interposed between the UCL and its insertion site. The patient must understand that UCL will never heal with conservative measures alone if a Stener lesion is present [11].

Extraarticular thumb metacarpal fractures typically occur at the base and present with apex dorsal angulation. Although closed reduction can be achieved with longitudinal traction and volarly directed pressure, these fractures are inherently unstable due to the deforming forces of the various tendinous insertions. Thus, ORIF with immobilization for 4 weeks is recommended. Angulation of less than 30 degrees is acceptable due to the mobile CMC joint.

Intraarticular thumb metacarpal base fractures present as either a Bennett fracture (without comminution) or a Rolando fracture (with comminution) [12]. ORIF with immobilization for 4 weeks is recommended for both, given the unstable nature of these fractures. We prefer a Wagner incision for our approach. The reduction maneuver consists of longitudinal traction, firm ulnarly directed pressure at the thumb metacarpal base, and mild pronation.

Dislocations

Finger DIP Joint

The distal interphalangeal (DIP) joint has a fairly stable construct, and therefore, dislocations affecting this joint are uncommon (Fig. 36.3). The dislocations are usually dorsal or lateral. Reduction can be achieved with longitudinal traction with pressure in the opposite direction of dislocation, for example, volarly directed pressure for dorsal dislocations. If unstable post-reduction, an extension-blocking splint can be considered [13].

Finger PIP Joint

Proximal interphalangeal (PIP) joint dislocations represent the most common ligamentous injury of the hand. A dorsal dislocation results from hyperextension combined with an axially directed force. Usually, there is injury to both the volar plate and collateral ligaments. Longitudinal traction must be avoided with dorsal PIP joint dislocation as the condyles can become trapped by the collateral ligaments with volar plate interposition in the joint, resulting in an irreducible dislocation [4]. The appropriate maneuver is to hook the middle phalanx over the PIP joint. If the reduction is unstable, an extension-blocking splint should be used. Operative management is indicated if the dislocation is irreducible or if the extension-blocking splint requires more than 30 degrees of flexion.

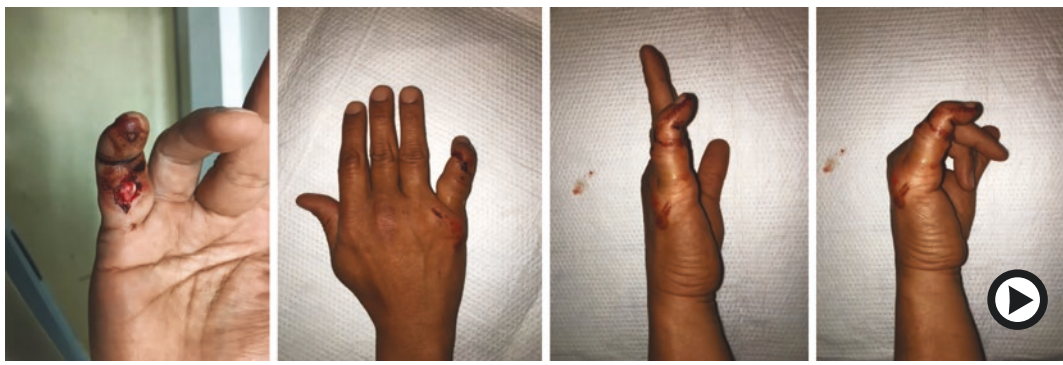

Fig. 36.3 A DIP joint dislocation (▶ https://doi.org/10.1007/000-3vf)

Volar dislocation of the PIP joint is uncommon but can occur due to a rotatory or non-rotatory mechanism. With the rotatory mechanism, injury has occurred to one of the collateral ligaments, and likely the central slip as well. Longitudinal traction should be avoided during reduction because the condyles can become trapped by the lateral bands. The MP and PIP joints are flexed to relax the lateral bands, followed by careful rotatory motion to free the lateral bands. Post-reduction, the finger is splinted in extension for 4–6 weeks.

Volar dislocations without a rotatory mechanism have associated central slip disruption with a likely soft tissue interposition. These injuries may require open reduction [1].

Finger MP Joint

The finger metacarpophalangeal (MP) joint will dislocate in either the dorsal or ulnar direction. This pattern of injury results from hyperextension. Reduction is similar to the principles used for PIP joints. Traction should be avoided, as this may pull the volar plate into the joint, thus converting a reducible injury into an irreducible one [14]. The maneuver consists of hooking the proximal phalanx over the metacarpal head by applying constant volarly and distally directed pressure. Wrist flexion may be helpful with relaxing the flexor tendons [1]. Irreducible fractures will require ORIF and splint immobilization for at least 4 weeks.

Conclusion

Thorough understanding of the anatomy and mechanics of the hand is critical in achieving satisfactory patient outcomes. Each component of the hand requires an individualized approach. The algorithms in this chapter will provide guidance and an understanding of the various treatment pathways for fractures and dislocations of the hand.

References

1. Day C, Stern P. Fractures of the metacarpals and phalanges. In: Wolfe SW, Hotchkiss RN, Kozin SH, Pederson WC, Cohen MS, editors. Green's operative hand surgery. 7th ed. Philadelphia: Elsevier; 2017.
2. Meals C, Meals R. Hand fractures: a review of current treatment strategies. J Hand Surg Am. 2013;38:1021–31.
3. Ruland RT, Hogan CJ, Cannon DL, Slade JF. Use of dynamic distraction external fixation for unstable fracture-dislocations of the proximal interphalangeal joint. J Hand Surg Am. 2008;33:19–25.
4. Kang R, Stern PJ. Fracture dislocations of the proximal interphalangeal joint. J Hand Surg Am. 2002;2:47–59.
5. Mcnemar TB, Howell JW, Chang E. Management of metacarpal fractures. J Hand Ther. 2003;16:143–51.
6. Diaz-garcia R, Waljee JF. Current management of metacarpal fractures. Hand Clin. 2013;29:507–18.
7. Wong VW, Higgins JP. Evidence-based medicine: management of metacarpal fractures. Plast Reconstr Surg. 2017;140:140e–51e.
8. Ben-amotz O, Sammer DM. Practical management of metacarpal fractures. Plast Reconstr Surg. 2015;136:370e–9e.
9. Dreyfuss D, Allon R, Izacson N, Hutt D. A comparison of locking plates and intramedullary pinning for fixation of metacarpal shaft fractures. Hand (N Y). 2019;14:27–33.
10. Najefi A, Jeyaseelan L, Patel A, Kapoor A, Auplish S. Avulsion fractures at the base of the 2(nd) metacarpal due to the extensor carpi radialis longus tendon: a case report and review of the literature. Arch Trauma Res. 2016;5:e32872.
11. Ritting AW, Baldwin PC, Rodner CM. Ulnar collateral ligament injury of the thumb metacarpophalangeal joint. Clin J Sport Med. 2010;20:106–12.
12. Carlsen BT, Moran SL. Thumb trauma: Bennett fractures, Rolando fractures, and ulnar collateral ligament injuries. J Hand Surg Am. 2009;34:945–52.
13. Sankaran A, Bharathi RR, Sabapathy SR. Complex dorsal dislocation of the distal interphalangeal joint: perspectives on management. Indian J Plast Surg. 2016;49:403–5.
14. Afifi AM, Medoro A, Salas C, Taha MR, Cheema T. A cadaver model that investigates irreducible metacarpophalangeal joint dislocation. J Hand Surg Am. 2009;34:1506–11.