THE SAN DIEGO KNEE CLINIC

Hand Metacarpal Fractures

We will be offering counseling on diet and exercise. If interested, please contact my office and schedule a medically supervised *Health and Orthopedic Fitness* assessment appointment which will include a spine and joint health assessment evaluation. This assessment will not be covered by health insurance.

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Proper treatment of hand and finger fractures requires a thorough understanding of both the gross and functional anatomy of the hand. General principles of managing fractures of the hand and finger are presented; classification of fractures is reviewed; and ways of caring for metacarpal injuries are discussed in depth.

The hand is a wonderfully complex structure that is both an intricate mechanical manipulator and one of the body's most delicate and discriminating sensory organs. From the standpoint of function, the hand and fingers are the most important components of the upper-limb complex. Because of its potential to perform a variety of tasks and its functional relationship to the rest of the body, however, the hand is particularly vulnerable to injury.

Although no reliable statistics on the numbers of metacarpal and phalangeal fractures are available, these parts of the skeletal system are probably the most commonly fractured. Unfortunately, it is also likely that no fractures are more often neglected or mistreated. Because these fractures are especially common and affect only small bones, some physicians may be somewhat lax about treating them. Yet proper treatment is essential—an error as simple as splinting a fractured digit in a nonfunctional position can result in the prolonged or permanent functional disability of a patient's finger (Haughton, 2012).

A number of basic principles must be followed to ensure optimal treatment of hand and finger fractures. Immobilization should be for as short a period as possible.

Functional impairment following a hand or finger fracture, such as deformity or joint stiffness, is all too common and results from improper treatment during the acute phase of the injury. Inadequate treatment is preventable, however, as the primary cause is lack of understanding of the basic anatomical principles governing the treatment of hand and finger fractures.

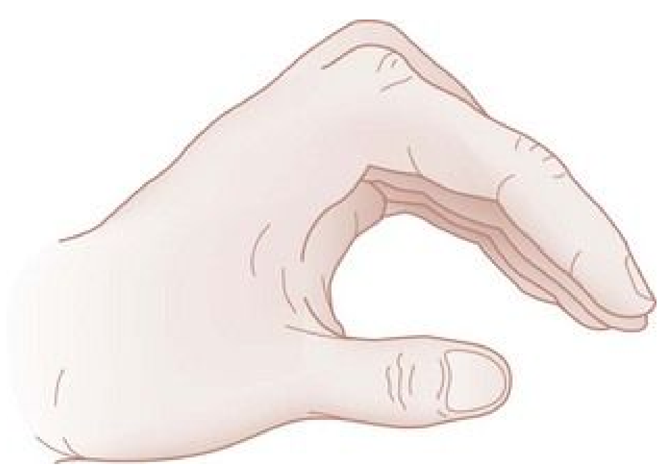

Figure 1. "Safe" position for hand and finger fractures

With few exceptions, the basics of caring for long-bone fractures also apply to caring for fractures of the hand and fingers. A number of principles are particularly important. Physicians should be careful not to underestimate the significance of finger injuries.

Dislocations that reduce spontaneously are often left untreated or undertreated. Because bone is frequently avulsed in these types of injuries, a radiographic evaluation of the injury is mandatory. The stability of the joint must also be evaluated. In some cases, surgical reconstruction of torn or avulsed ligaments is necessary to restore stability and function.

Displaced intraarticular fractures of greater than a few millimeters that involve more than 20% to 25% of the joint surface are generally unstable and almost always require percutaneous pin fixation or open (surgical) reduction with internal fixation (Fok, 2013). Anatomical reduction is especially important with hand and finger fractures. Edema and lymphatic stasis are also of particular concern following a hand or finger injury. During the acute phase of the injury, care should be taken not to compromise circulation to the affected area. In addition, splinting may be more effective than casting until swelling around the injury subsides. The patient should also be encouraged to elevate the affected hand and to actively move the unaffected fingers as much as possible.

Both angular and rotational deformities must be corrected. When flexed, all fingers should point to the tubercle of the scaphoid, and the injured hand should be compared with the contralateral hand to ensure rotational symmetry. The hand and fingers must be immobilized in the position of function (Figure 1), with the wrist slightly extended, the fingers flexed 30 to 45 degrees, and the thumb normally opposed. In this position, the intrinsic and extrinsic muscles are at their normal resting length.

With few exceptions, a fractured proximal/distal phalangeal joint should never be immobilized in extension, particularly when the metacarpophalangeal joint is involved. Splinting in extension can result in malalignment of the fracture and stiffness of the finger. If immobilization in extension is necessary, the extended position should be maintained for as short a period as possible (Kollitz, 2014).

Immobilization should be discontinued as soon as possible, and active motion begun to reduce fibrosis and stiffness in the affected part. For most fractures of the phalanges, a maximum of four weeks of immobilization is sufficient to ensure adequate healing time. In addition, a minimum amount of padding should be used when casting hand fractures. Excess padding will leave too much room in the cast, allowing the intrinsic musculature to increase the angular deformity of the fracture. Traction should only be used for hand and finger fractures when other methods, such as casting, splitting, or internal fixation, have failed or are contraindicated. Prolonged excessive traction can result in tissue ischemia, and possibly, nonunion of the bone. When rehabilitating hand or finger fractures, vigorous passive stretching exercises are contraindicated, because of the danger of refracturing or of tearing the healing soft-tissue structures. Finally, undue pressure of the cast or splint on the fracture site should be avoided. Excessive pressure on the injury may force a tendon into the fracture site, resulting in adhesions and joint stiffness.

Failure to correctly classify fractures will likely result in improper treatment and in deformity and dysfunction.

Fractures of the hand and fingers are classified by the site and nature of the fracture. A fracture may be either closed or compound (open), intraarticular or extraarticular, stable or unstable. A fracture may also be classified as complete, incomplete, comminuted, transverse, oblique, or spiral (Wiegand, 2012). Furthermore, fractures of the metacarpals and phalanges are classified according to their location such as the base, shaft, neck, or head (Figure 2). All of these factors have a definite bearing in the treatment of the injury. Because deformity is a common result of hand and finger fractures, taking multiple x-ray views is mandatory to determine severity. Is is also important to remember that deformity can result not only from the mechanism of the injury, but also from musculotendinous force acting across the fracture site.

With open or compound fractures of the hand or fingers, the fracture site should be carefully inspected and debrided, and the extent of soft-tissue or tendon injury determined.

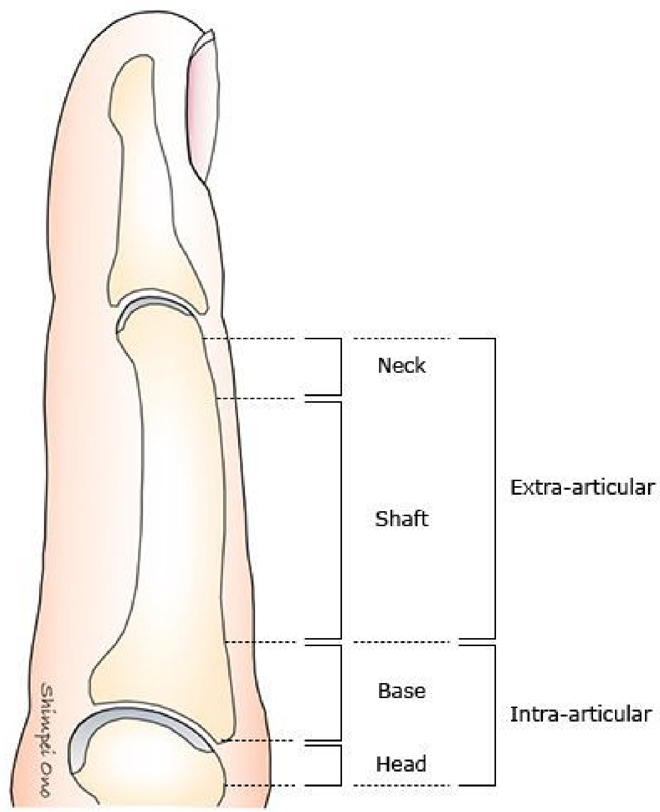

Figure 2. Fracture locations

If significant soft-tissue disruption is detected, with evidence of tendon impairment, the patient should be immediately referred to a qualified surgeon for further treatment.

In general, markedly displaced intraarticular fractures must be considered unstable, and they require anatomical reduction with internal fixation. Stable fractures, without significant displacement, can be maintained in a cast or splint, with the hand or finger in the functional position. Unstable fractures are usually oblique or spiral in configuration cannot be maintained by conservative means, because of intrinsic muscular forces. For these fractures internal fixation is usually the method of choice.

Metacarpal bone fractures are some of the most frequently missed injuries. Bennett's fractures are usually unstable and require internal fixation.

Metacarpal fractures must be treated carefully to prevent deformity and functional impairment (Griffin, 2012). After a fracture, the tendons of the intrinsic muscles on the palmar of the hand act to increase the deformity, usually dorsal angulation. In treating these fractures, care must be taken to reduce both angular and rotational deformity, particularly if the metacarpal neck is involved; otherwise, the normal muscular balance of the hand will be disrupted, resulting in functional impairment.

Fractures at the base of the metacarpals most often are the result of a direct blow along the metacarpal axis. These fractures are some of the most frequent missed metacarpal injuries. Thorough radiographic evaluation with multiple views is essential for all patients complaining of pain or swelling at the metacarpal base. Fortunately, most fractures of the base of the finger metacarpals (particularly the third and fourth metacarpal bases) are stable, because they are surrounded by periosteum and protected by adjacent soft tissue and bone. Rotational deformity and disruption of the surrounding soft tissue are the principal concerns with these fractures.

Nondisplaced fractures respond well to four to six weeks of casting. The hand is casted in slight dorsiflexion, with the fingers left free. If these fractures are unstable or involve the articular surface, however, anatomical reduction with percutaneous pins or open reduction with internal fixation is indicated (Borchers, 2012).

The metacarpal of the thumb differs significantly from the finger metacarpals, because of its greater range of motion (flexion, extension, adduction, abduction, opposition, and circumduction) and its greater reliance on soft tissue for stability. Thumb metacarpal fractures, therefore, are treated differently than fractures of the finger metacarpals.

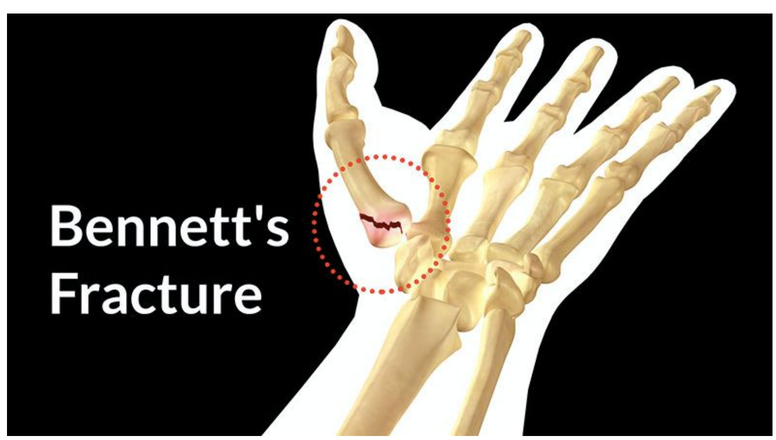

Figure 3. Bennett's fracture of the thumb metacarpal base

The majority of thumb metacarpal fractures involve the base. The most frequently encountered being the Bennett's fracture (Figure 3), an oblique fracture through the base of the first metacarpal, with gross displacement of the volar/medial fragment.

Bennett's fracture is caused by a force directed along the axis of the metacarpal shaft, resulting in a fracture dislocation of the base. Capsular structures responsible for joint stability are usually disrupted as well. Anatomical reduction is essential to prevent malunion of the bone, which can result in osteoarthritis of the joint, pain, and loss of function, and may eventually require arthrodesis.

Simple immobilization of a Bennett's fracture is usually disappointing because it is a very unstable injury. Internal fixation is preferable, with one or two small Kirschner wires (K-wires) placed percutaneously to transfix the fracture fragments (Biz, 2014). Often, when anatomical reduction cannot be achieved with percutaneous pinning, a direct surgical approach is indicated. Surgery may also be required to repair torn capsular structures and to restore joint stability. After it is reduced, a short-arm thumb spica cast is applied with the thumb in opposition. The cast should extend distal to the interphalangeal joint. Active exercise of non-immobilized fingers is encouraged during the period of immobilization. Immobilization should last six weeks, after which the pins are extracted, and a physical therapy program is instituted to restore strength and normal functioning (Chen, 2008).

Transverse or oblique extraarticular fractures near the base of the thumb metacarpals are less common. Fortunately, these fractures are usually stable and, with local anesthesia, can be reduced by closed manipulation. Once reduced, the fracture should be immobilized with a short-arm thumb spica cast with the thumb opposed, taking care to avoid hyperextension. With an unstable oblique fracture, the reduction can be maintained by percutaneous pinning to stabilize the fracture. The thumb should remain immobilized for four to six weeks, after which physical therapy can be started to restore normal strength and functioning of the thumb and hand.

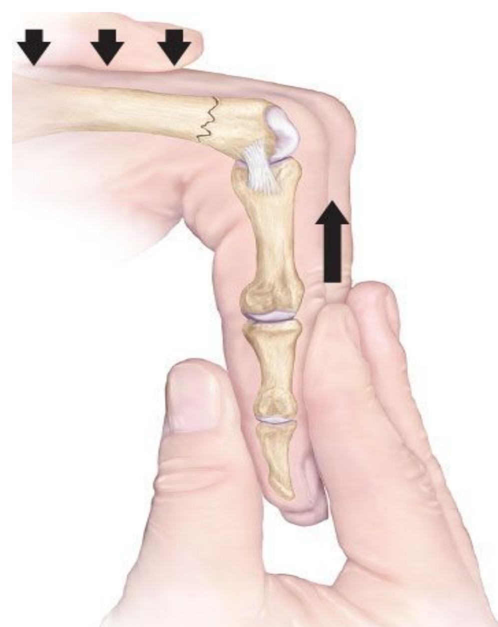

Figure 4. Dorsal angulation caused by musculotendinous force in an metacarpal shaft fracture.

Fractures of the second and fifth metacarpal shafts generally involve dorsal angulation, as do fractures of the metacarpal neck. Metacarpal head fractures frequently result in long-term dysfunction.

Fractures of the third and fourth metacarpal shafts usually involve only minimal displacement and angulation. Because of the surrounding intermetacarpal and ligamentous support. Fractures of the second and fifth metacarpal shafts (Figure 4). Frequently do involve angulation and displacement, usually exhibiting dorsal angulation caused by the force of the musculature at the palmar surface of the hand.

Reduction is achieved by applying traction along the axis of the metacarpal and applying dorsal pressure over the apex of the fracture. If the fracture is stable following reduction, the fingers of the fractured metacarpals are splinted in flexion and incorporated in a short-arm cast to immobilize the hand. If significant displacement or instability of the fracture is evident following reduction, however, percutaneous pinning to the adjacent metacarpal is indicated to stabilize the fracture. Internalization is indicated for stabilizing significantly displaced oblique or spiral fractures, especially of the second and third metacarpals. If multiple metacarpals are involved, intramedullary pinning is usually most effective. Comminuted fractures are reduced with plates affixed to the bones.

Following immobilization of four to six weeks, the pins are removed (although the plates may be left in place), and an active rehabilitation program is begun. Fractures of the metacarpal neck, particularly of the fifth, are perhaps the most common of the metacarpal fractures. These fractures are called “boxer’s” fractures (Figure 5), because they most often result from contact of a clenched fist with an immovable object (such as an opponent’s skull). They are characterized by dorsal angulation caused by comminution of the volar cortex at the fracture site (Kollitz, 2014).

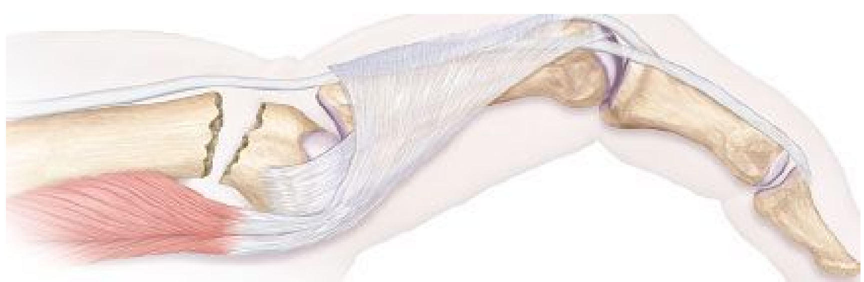

Figure 6. Boxer’s fracture, with dorsal angulation and comminution of the volar cortex of the metacarpal.

This type of fracture is reduced by flexing the metacarpophalangeal joint to 90 degrees. Pressure is then applied posteriorly along the axis of the metacarpal to push the metacarpal head back into a normal or near-normal anatomical position. (Somewhat more angulation of this fracture can be tolerated than with most other fractures). Once the fracture is reduced to less than 30 degrees of angulation, a volar splint is applied to the affected finger, with the finger flexed 65 degrees at the metacarpophalangeal joint. The splint is then incorporated into a short-arm cast to immobilize the hand. “Buddy” taping to the adjacent finger can also be used to provide additional stability and enhanced support.

Because communication of the volar cortex makes fractures of the metacarpal neck essentially unstable, the intrinsic musculature at the palmar surface of the hand may cause dorsal angulation of the fracture, both soon after the reduction and during the period of immobilization. X-rays should be obtained every four days for two weeks to ensure proper alignment of the fracture; and the fracture should remain immobilized for four to six weeks.

Fortunately, fractures of the metacarpal head are not common. These fractures are usually the result of a crushing injury. Most frequently, they are comminuted, and attempts at reduction—even open reduction with internal fixation—are often useless. This type of fracture should initially be immobilized with distal traction until the joint can be moved without excessive pain. Motion is then begun in the hope that the fragments will assume some sort of functional alignment. The long-term prognosis for fractures of the metacarpal head, however, usually involves significant restricted motion and posttraumatic arthritis.

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