

Metacarpal Fractures

Surgical Indications and Considerations

Anatomical Considerations: Injuries to the hand often involve damage to multiple tissues. Soft tissues commonly involved with fractures include cartilage (with intra-articular fractures), joint capsule, ligaments, fascia, and dorsal hood fibers. In severe polytrauma cases, tendons and nerves may also be injured. Many metacarpal fractures heal within 3 to 7 weeks, depending on the location of the fracture. The anatomic locations often used for description of metacarpal fractures are the base, shaft, neck, and head.

Pathogenesis:

Description: Metacarpal fractures represent 35% of hand fractures and most commonly involve the first and fifth rays. Many metacarpal fractures heal within 3 to 7 weeks, depending on the location of the fracture.

Metacarpal Base Fracture: These fractures result from high forces (violent accidents), direct blow, or crushing injury, in which several metacarpals are often involved and occur intra-articular. They may also occur with an avulsion of the wrist flexors or extensors resulting from a direct blow or torsional injury. Most common occurrence is at the 5th metacarpal-hamate articulation. The healing rate varies from 3-6 weeks.

Metacarpal Shaft Fracture: These fractures are produced by longitudinal compression, torsion, or direct impact and occur extra-articular. Fractures can be categorized into comminuted, transverse, spiral, or oblique types. They are slower to heal than the more distal or proximal locations because of the predominantly cortical bone found there. The healing rate varies from 3-7 weeks.

Metacarpal Neck Fracture: These fractures result from a compression force such as a direct blow with a closed fist. The weakest point of the metacarpal bone is the extra-articular neck. These fractures most often occur in the fourth or fifth metacarpal and are often referred to as a “boxer’s” fracture. Trauma causes the fractured metacarpal head to displace with volar angulation. The healing rate is 3-5 weeks.

Metacarpal Head Fracture: These fractures result from direct impact and high axial loads, which can involve avulsion of the collateral ligaments, and extensive comminution is common. These fractures are usually intra-articular and most often require open reduction and fixation.

Etiology: Metacarpal fractures represent 35% of hand fractures and most commonly involve the first and fifth rays. The neck fracture is the most common location for metacarpal fractures because it is the weakest portion of the bone. These fractures occur more commonly from punching-type sports (boxing, martial arts).

Non-operative versus Operative Management: The majority of metacarpal fractures can be treated without surgery, using closed methods that emphasize alignment and early protected motion. All splinting programs recognize the need to position the metacarpophalangeal joints in flexion and the interphalangeal joints in full extension, with exception of volar plate fractures. Unpublished data by Greer states that the following (REDUCE) principles should be incorporated in all splinting designs. (1) **R**eduction of the fracture is maintained, (2) **E**liminate

contractures through positioning, (3) Don't immobilize fractures more than 3 weeks, (4) Uninvolved joints should not be splinted in stable fractures, (5) Creases of the skin should not be obstructed by the splint, and (6) Early active tendon gliding is encouraged. When surgery is indicated it is the choice of implant that drives the course of fracture healing. Primary bone healing is accomplished through rigid fixation. One advantage of primary healing via rigid fixation is precise anatomic reduction. This is especially important in articular fractures where joint incongruities could potentially lead to degenerative joint pathologies. The disadvantage is that there are now 2 wounds to heal: the fracture and the soft tissue incision. Secondary bone healing is accomplished through coaptive implants. One advantage of secondary healing is that there is minimal soft tissue disruption which equates to less scar remodeling. The disadvantage however is the long period of protective immobilization required which can lead to soft tissue contractures and atrophy.

Surgical Procedure: Surgery is performed when fractures cannot be reduced with closed manipulation or when closed techniques fail to maintain adequate fracture alignment and stability. The hardware used in fracture fixation falls into 2 categories: The first is coaptive fixation, which uses devices such as external fixators, intramedullary rods, Kirschner's (K) wires, pins, or interosseous wiring, which hold the fracture together without compression. The second is rigid fixation, which uses devices such as plates, screws, tension band wiring, and 90-90 wiring, which holds the fracture together with compression.

Acute Stage / Severe Condition: Physical Examinations Findings (Key Impairments)

ICF Body Functions code: b7101.3 SEVERE impairment of mobility of several joints

- Swelling and ecchymosis around the involved joint and/or the entire hand
- Loss of active and passive mobility of the involved joint
- Severe tenderness to palpation of the involved joint

Sub Acute Stage / Moderate Condition: Physical Examinations Findings (Key Impairments)

ICF Body Functions code: b7101.2 MODERATE impairment of mobility of several joints

As above, except:

- Moderate swelling
- Moderate loss of active and passive mobility of the involved joint
- Moderate tenderness to palpation of the involved joint

Settled Stage / Mild Condition: Physical Examinations Findings (Key Impairments)

ICF Body Functions code: b7101.1 MILD impairment of mobility of several joints

As above, except:

- Mild swelling
- Mild loss of active and passive mobility of the involved joint
- Mild tenderness to palpation of the involved joint

Intervention Approaches / Strategies

Closed Reduction Management

Acute Stage / Severe Condition: Weeks 1-3

Goals: Control edema and pain
External support

- Coban wrap compression
- Ice, elevation, TENS
- Position MP joint at 70 degrees of flexion in protective splint

Sub Acute Stage / Moderate Condition: Weeks 2-5 (Fx. Stable)

Goals: Control any residual symptoms of edema and pain
Prevent MP joint contractures
Prevent intrinsic muscle contracture
Protected mobilization and tendon gliding

- Coban wrap compression
- Ice, elevation, isometric muscle contraction of intrinsic (maintain MP flex/IP ext)
- Protective dynamic or progressive MP joint flexion splint
- Instruct patient in intrinsic stretch
- Initiate tendon gliding

Settled Stage / Mild Condition: Weeks 5-8 (Healed Fx.)

Goals: Full Range of Motion
Prevent increased edema or pain
Return to light functional use

- PROM at all joints
- Joint mobilization techniques
- Dynamic splinting for joint or tendon tightness
- Incorporate hand use in daily activities
- Continue tendon gliding exercises
- Ice and elevation as needed

Intervention for High Performance / High Demand Functioning in Workers or Athletes: Wks 8+

Goals: Normalize strength
Initiate sport specific or job specific skill development

- Progressive resistive exercises
- Sport specific/job specific activities

Open Reduction Management

- * Coaptive Fixation (CF)
- * Rigid Fixation (RF)

Acute Stage / Severe Condition: Weeks 1-3

Goals: Control edema and pain

Prevent infection

Protect fracture healing with splint

Controlled mobilization and tendon gliding

Full active range of motion is early goal for RF

Controversy over CF motion-protective AROM (Weiss study)

- Coban wrap compression/Isotoner glove
- Ice and elevation
- Wound debridement/infection control
- Removable splint for suture/pin cleaning and protected AROM for CF
- Dynamic splints for soft tissue stretching with RF
- Instruct patient in tendon gliding

Sub Acute Stage / Moderate Condition: Weeks 4-6

Goals: Protect fracture healing with splint (K-wires and pins removed)

Control any residual symptoms of edema and pain

Prevent scar contracture

Restore AROM

Begin strengthening (for RF)

- Removable splint for protection and AROM out of splint
- Ice, compression, and elevation as needed
- Friction massage for scar
- AROM exercises performed out of splint hourly towards full ROM.
- Strengthening with light resistance (for RF)

Settled Stage / Mild Condition: Weeks 6-8

Goals: Begin strengthening (for CF)

Full range of motion (for CF)

Progressive strengthening (for RF)

Monitor edema and pain

- Early strengthening at light resistance
- Dynamic or serial static splints to overcome soft tissue contractures
- Progressive resistive exercises (light) continued (RF)
- Ice and elevation as needed

Intervention for High Performance / High Demand Functioning in Workers or Athletes: Wk 8+

* Same as Closed Reduction Management and Rehabilitation *

Selected References:

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