



## Metacarpal Fractures

Issue 14

Fractures of the metacarpals are common injuries, representing 40% of all upper extremity fractures [1]. This is similar for paediatric fractures [2]. The majority (70%) occur within the second and third decades of life and result from accidental falls or direct blows to another object or individual [3].

The goal of treatment is to achieve optimal hand function with acceptable fracture alignment, strong bony union, and unrestricted motion [5]. For non-operative management, studies report several different protocols with varying periods of immobilization. This means that clinicians rely on clinical experience and low-level evidence to guide management [5].

### Anatomy

The length of each metacarpal varies purposefully to support function. The index finger metacarpal is the longest and most stable. The index and long fingers have 0 degrees of motion at their CMC joint because of their rigid interlocking joint anatomy. The ring and little finger metacarpals are of decreasing length and increasing CMC joint mobility, 15 degrees and 25 degrees respectively [6].

Because of the intrinsic and extrinsic muscle forces on the metacarpus, fractures of the metacarpals tend to have an apex dorsal angulation deformity [7]. Angular malunion in the metacarpal is generally in the sagittal plane with an apex-dorsal deformity. Such malunion is usually seen with transverse shaft fractures, as the combination of the long flexors and intrinsics are stronger than the extrinsic extensors [8].

### Radiology

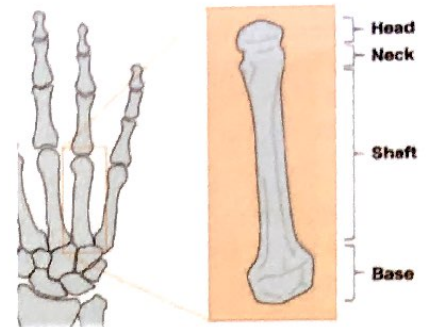
Posteroanterior and oblique views are mandatory. When the 4<sup>th</sup> and 5<sup>th</sup> metacarpals are injured, lateral views should be optimally taken with 30-degree pronation and for injury to the radial metacarpals with 30 degrees supination. However, angulation of the metacarpal bones is often best seen with a true lateral view [9].

With dorsal angulation, measurement on lateral x-ray may be prudent to define the precise amount of angulation [9]. Patients should be referred for a repeat X-ray if the fracture is considered unstable or if they present with significant pain, rotation or angulation with a high suspicion of fracture movement [11].

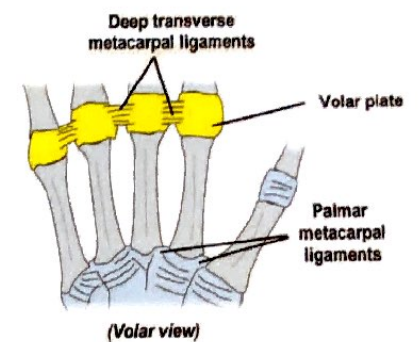
### Assessment

The key parts of the clinical examination are to assess the degree of rotational deformity and whether there is any soft tissue compromise, including evidence of compound fractures [9].

The digits of all four fingers should point towards the scaphoid tubercle, with the MCP and PIP Joints flexed. Likewise, the nail should appear parallel to the hand and neighbouring digits when looking end-on [9]. Examination requires noting the



Metacarpal Anatomy [4]



Ligamentous Support of the Metacarpals [4]



PA View of 4<sup>th</sup> metacarpal oblique fracture [10]



Typical Volar Angulation

alignment of the nail plates, as well as looking for scissoring or overlap as the patient slowly makes a fist. For patients who are unable to perform active flexion, the digital cascade can be observed through the tenodesis effect by flexing and extending the wrist [3]. Even five degrees of rotation will yield a 1.5-cm digital overlap with both aesthetic and functional deformity. Each degree of metacarpal fracture rotation may produce as great as five degrees of rotation at the fingertips [12].

The digits should be viewed end-on in full extension as well as fully flexed. In digital extension, the index and little fingers angulate toward the middle finger [13]. Indications for surgery include; open fractures, intra-articular fractures, angulation of the fracture greater than 30 degrees, rotational deformity greater than 10 degrees and gross (>5mm) shortening of the metacarpal. Likewise, the irreducible or unstable fracture requires operative management, as does multiple digit involvement [9].

**Treatment**

The literature shows a lack of consistency in the mode of immobilisation, position, material used (plaster, thermoplastic, or other) and period of immobilisation among studies of conservative management [14]. Management varies from immobilisation, protected mobilisation to no protection at all [11]. Some practices do not attempt reduction in the majority of metacarpal neck and minimally displaced shaft fractures because of the difficulty in maintaining this closed reduction [4].

**Metacarpal Head** fractures can be treated nonoperatively or with closed reduction and internal fixation if the joint involvement is <20%. Protective immobilization requires either a radial or an ulnar gutter splint, which includes the neighbouring digit and holds the MCP joints in 70 to 90 degrees of flexion and interphalangeal joints in extension for 3 weeks. The goal of this positioning is to maintain the length of the MCP collateral ligaments, prevent claw posture and draw the extensor hood into a distal and tightened position around the metacarpal head fracture [6]. There is no evidence to suggest that the wrist joint should be immobilised [11].

**Metacarpal Neck.** Ali and others [15] studied the effect of metacarpal neck fracture angulation at progressive flexion angles on the ability of the intrinsic muscles to initiate grip. They found that angulation of >30 degrees weakened the little finger's initiation of grip. They therefore recommended 30 degrees as the limit for acceptable angulation [6].

Studies comparing four weeks of POP casting to elastic bandaging show reduced range of motion in the casted patients and significantly more pain in the bandaged patients [11]. This shows that a treatment somewhere in the middle of these is required. A study comparing a hand-based circumferential thermoplastic splint that allowed full motion of the MCP Joint and Wrist to buddy strapping showed that patients treated with the brace complained of less pain, greater range of motion and earlier return to work than the patients treated only with buddy strapping [11].

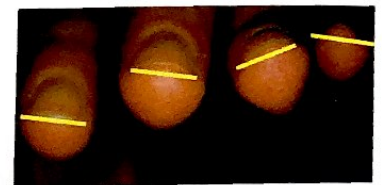
**Metacarpal Shaft.** More than three weeks of immobilisation can lead to significant loss of hand function [11]. For less stable metacarpal shaft fractures, a forearm-based wrist splint should be used to position the wrist in 20 degrees of extension with a dorsal hood holding the MCP Joints in flexion. This will limit any deforming forces of Extensor Digitorum Communis. Once a soft bone callous has formed by three weeks after injury, the dorsal hood can be removed [11]. Very stable shaft fractures can manage with a hand-based brace.



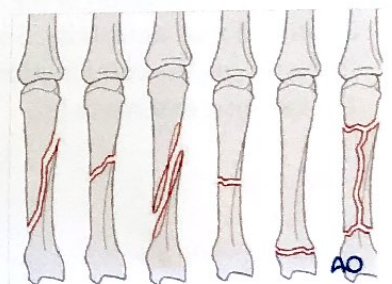
Normal cascade of flexion [9]



Normal patterning [8]



Malrotation of (L) Ring Finger



Fracture Types

Finger	Angulation (degrees)
<b>Neck</b>	
Index	10
Middle	15
Ring	30
Small	40
<b>Shaft</b>	
Index	0
Middle	0
Ring	20
Small	30

Degrees of acceptable angulation of neck and shaft fractures

**Metacarpal Base** fractures are classified as intra or extraarticular. Stability of these fractures is determined by the volar and dorsal carpometacarpal and carpometacarpal joint increases in a radial to ulna direction [11]. Intra-articular base fractures with no or minimal displacement were treated with a forearm-based wrist immobilisation splint or POP for four weeks, all with satisfactory outcomes and no compromise in grip strength. [11].



Hand-based radial gutter splint

### Restoring Movement

**Range of Motion Exercises** are typically started at three weeks post injury for the affected joints. However, should there be good stability but concerns with stiffening these can be moved forwards to two weeks. Conversely, if there are stability concerns then this should be delayed until four weeks. Unaffected joints are usually safe to move immediately.

**Static progressive splinting** takes tissue to an end range but does not try to push through this point. The concept involves growth and reorganisation of collagen fibres to allow increased range of motion [16]. Some techniques have an adjustable component through a guitar tuner or turnbuckle which allows the patient to increase or decrease tension to improve comfort or increase range. This gives the patient the ability to control the total time in the splint, so that the tissue does not become reactive by spending too long in one position. Serial casting works in a similar fashion by holding the structures at end range. This is commonly used by patients overnight to restore extension range in PIP Joint flexion contractures.



Forearm based brace appropriate for fracture of the metacarpal base

**Dynamic splinting** uses spring or elastic components to regain range. The benefit of dynamic splinting is that tissue is always held at the limit of range. It is important that the force is not excessive as this can encourage tissue to react and in fact pull in the opposite direction. As always, clearly monitoring changes in range and comfort allows the therapist and patient to decide which method is best. Spring loaded splints such as LMB or Capener splints are commonly used and allow a patient to regularly don and doff the splint for Proximal Interphalangeal (PIP) Joint flexion contractures, which are a common sequela of metacarpal fractures.



Serial Casting for PIP Joint extension

**CMMS casting** is a technique in which splints or casts immobilise joints which are working well, so that less mobile or less selectively used joints are encouraged to move more [17].

**Relative Motion splinting.** Using a small splint to push one MCP Joint into more flexion relative to its neighbour can encourage the affected MCP joint to flex further. This type of splint can also be useful to selectively improve active extension of a Proximal Interphalangeal joint on the same finger.



CMMS casting

### Strengthening

Strengthening and endurance exercises are commenced once there is some evidence of fracture healing. Progressive resolution of local tenderness at the fracture site is an important guide to progress [9]. When things are progressing normally, steady improvements in grip strength measures should be noted to match the increasing force applied and adjustments made accordingly. Intrinsic muscle shortening and altered muscle tension dynamics can lead to progressive grip weakness after approximately 30 degrees of dorsal metacarpal angulation [12]. At times the body may display signs of inhibition due to pain. However, by carefully applying load in grip or using adduction or abduction loading of the fingers, a patient can steadily restore strength and confidence in the finger.



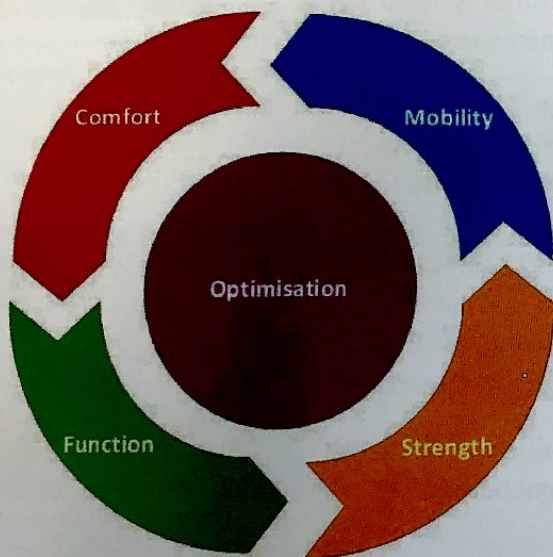
Relative Motion Splint

## Key points

- The majority of metacarpal fractures should be splinted for at least three weeks.
- A splint should be determined by the site and the classification of fracture
- Active range of motion should be initiated by three weeks in the majority of cases, unless there are concerns with stability
- There are several splinting methods which can be used to restore range of motion should progress with active movements plateau.

## References:

- [1] Balaram AK, Bednar MS. Complications After the Fractures of Metacarpal and Phalanges. *Hand Clin* 26 (2010) 169–177 doi:10.1016/j.hcl.2010.01.005
- [2] Cornwall R. Finger Metacarpal Fractures and Dislocations in Children. *Hand Clin* 22 (2006) 1–10 doi:10.1016/j.hcl.2005.12.001
- [3] Diaz-García R, Waljee JF. Current Management of Metacarpal Fractures. *Hand Clin* 29 (2013) 507–518 <http://dx.doi.org/10.1016/j.hcl.2013.09.004>
- [4] Wong VW, Higgins JP. Evidence-Based Medicine: Management of Metacarpal Fractures. *Plast Reconstr Surg* 140 (2017) 141e–151e. doi: 10.1097/PRS.0000000000003470
- [5] Retrouvey H, Morzycki A, Wang AM, Binhammer P. Are We Over Treating Hand Fractures? Current Practice of Single Metacarpal Fractures. *Plas Surg* 26(3) (2018) 148–153 doi:10.1177/2292550318767926
- [6] McNemar TB, Howell JW, Chang E. Management of Metacarpal fractures. *J Hand Ther.* 2003 Apr-Jun;16(2):143–51. doi: 10.1016/s0894-1130(03)80009-1
- [7] Adams JE, Miller T, Rizzo M. The biomechanics of fixation techniques for hand fractures. *Hand Clin.* 2013 Nov;29(4):493–500. doi: 10.1016/j.hcl.2013.08.004. Epub 2013 Oct 15. PMID: 24209948.
- [8] Houghton D, Jordan D, Malahias M, Hindocha S, Khan W. Principles of hand fracture management. *Open Orthop J.* 2012;6:43–53. doi: 10.2174/1874325001206010043
- [9] Singletary S, Freeland AE, Jarrett CA. Metacarpal fractures in athletes: treatment, rehabilitation, and safe early return to play. *J Hand Ther.* 2003 Apr-Jun;16(2):171–9. doi: 10.1016/s0894-1130(03)80012-1
- [10] Giddins G. The Nonoperative Management of Hand Fractures in United Kingdom. *Hand Clin.* 2017 Aug;33(3):473–487. doi: 10.1016/j.hcl.2017.04.006
- [11] Toemen A, Midgley R. (2010). Hand therapy management of metacarpal fractures: an evidence-based patient pathway. *J Hand Ther.* 2010 15(4) 87–93 <https://doi.org/10.1258/ht.2010.010018>
- [12] Freeland AE, Lindley SG. Malunions of the finger metacarpals and phalanges. *Hand Clin.* 2006 Aug;22(3):341–55. doi: 10.1016/j.hcl.2006.03.001
- [13] Lee SG, Jupiter JB. Phalangeal and metacarpal fractures of the hand. *Hand Clin.* 2000 Aug;16(3):323–32
- [14] Taha R, Leighton P, Bainbridge C, Montgomery A, Davis T, Karantana A. Protocol for surgical and non-surgical treatment for metacarpal shaft fractures in adults: an observational feasibility study. *BMJ Open.* 2021 Jun 29;11(6):e046913. doi: 10.1136/bmjopen-2020-046913
- [15] Ali A, Hamman J, Mass DP. The biomechanical effects of angulated boxer's fractures. *J Hand Surg Am.* 1999 Jul;24(4):835–44. doi: 10.1053/jhsu.1999.0835
- [16] Glasgow C, Tooth LR, Fleming J, Peters S. Dynamic splinting for the stiff hand after trauma: predictors of contracture resolution. *J Hand Ther.* 2011 Jul-Sep;24(3):195–205; quiz 206. doi: 10.1016/j.jht.2011.03.001
- [17] Midgley R. Case Report: The casting motion to mobilize stiffness technique for rehabilitation after a crush and degloving injury of the hand. *J Hand Ther.* 2016 Jul-Sep;29(3):323–33. doi: 10.1016/j.jht.2016.03.013



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