YanShan LU # hand

Fractures: hand

Hand Therapy Training Program 2015

Acknowledge of Julie Collis

22nd May fractures sustained from a fall during a squash game

Metacarpal fractures

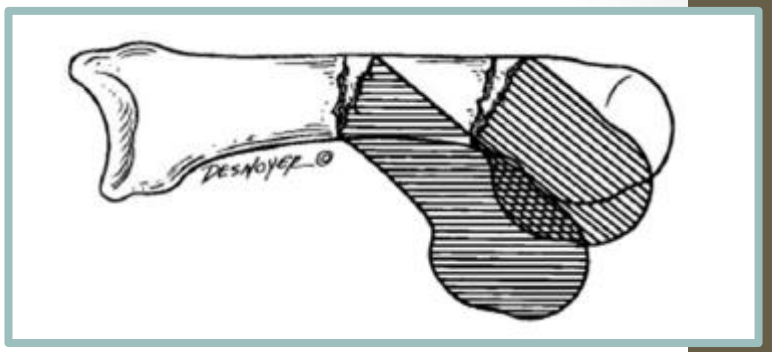
- 30 % of all hand fractures (Diaz-Garcia, 2013)
- Rich blood supply to MCs – enables good healing especially head and base (McNemar, 2003)
- Consolidation 3-5/52

Types

- MC head, neck (boxers), shaft, base
- Transverse, spiral, oblique
- IA base of MC – deforming force from wrist flexors/extensors

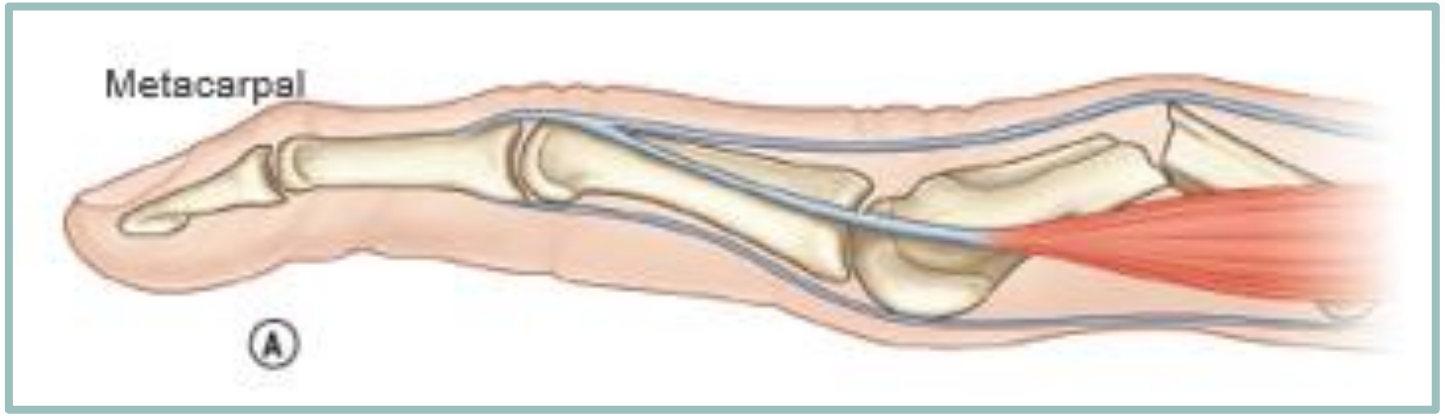
Metacarpal fractures

- angulation



- Distal fragment flexes / dorsal apex from pull of interosseous
- ≤ 40º angulation tolerated in LF; 10º in IF
- The more proximal the fracture, the greater the palmar prominence
- MC shortening > 5mm decreases finger flexion force
- ± 7º extensor lag per 2mm MC shortening

(Cotterell, 2015; Diaz-Garcia, 2013; Strauch, 1998; Wills, 2012)



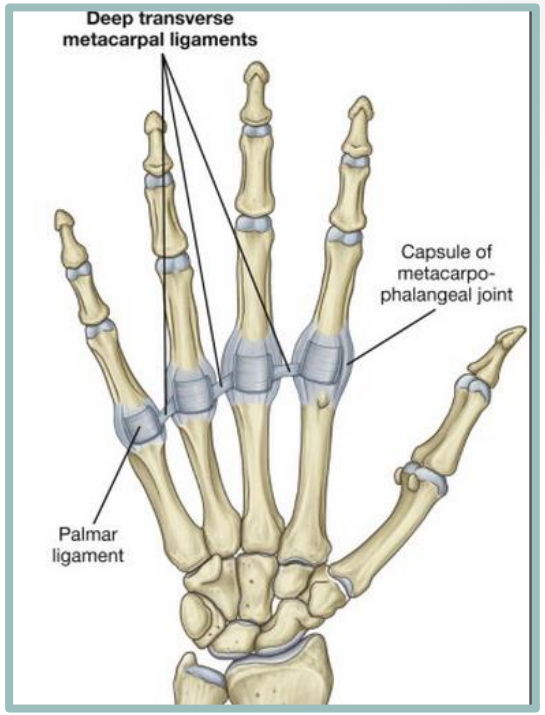
Hand fractures and joint injuries

Plastic Surgery.

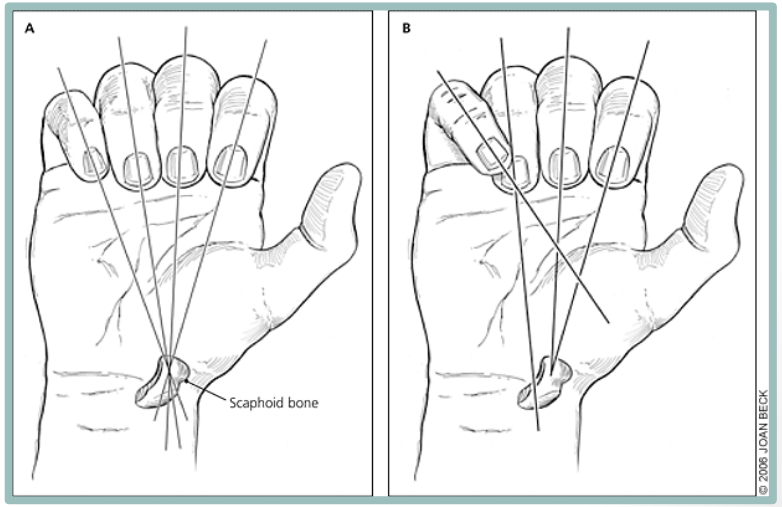
Hammert, Warren C.. Published January 2, 2013. Pages 138-160.e3. © 2013.

Fig. 7.1 Angular deformity associated with fractures of the metacarpal and phalanges. (A) Metacarpal fractures typically have apex dorsal angulation secondary to the location of the interosseous muscles while the proximal phalanx fractures (B) have an apex volar angulation. The angulation of middle phalanx fractures is dependent o the location of the fracture, relative to the insertion of the FDS tendon: fractures proximal to the insertion (C) will have apex dorsal angulation while those distal (D) will have apex volar angulation.

Metacarpal fractures - rotation



- Transverse inter-metacarpal ligament gives rotational stability to distal fragment; particularly 3rd & 4th MC
- 5º rotation = 1.5cm digital overlap
- Observe finger in extension and flexion
  - Flexion cascade towards scaphoid
  - orientation of fingernail
  - scissoring



(Diaz-Garcia, 2013; Strauch, 1998; Wills, 2012)

Metacarpal fracture management

Hand therapy dependent on location, stability and surgical management; protocols vary

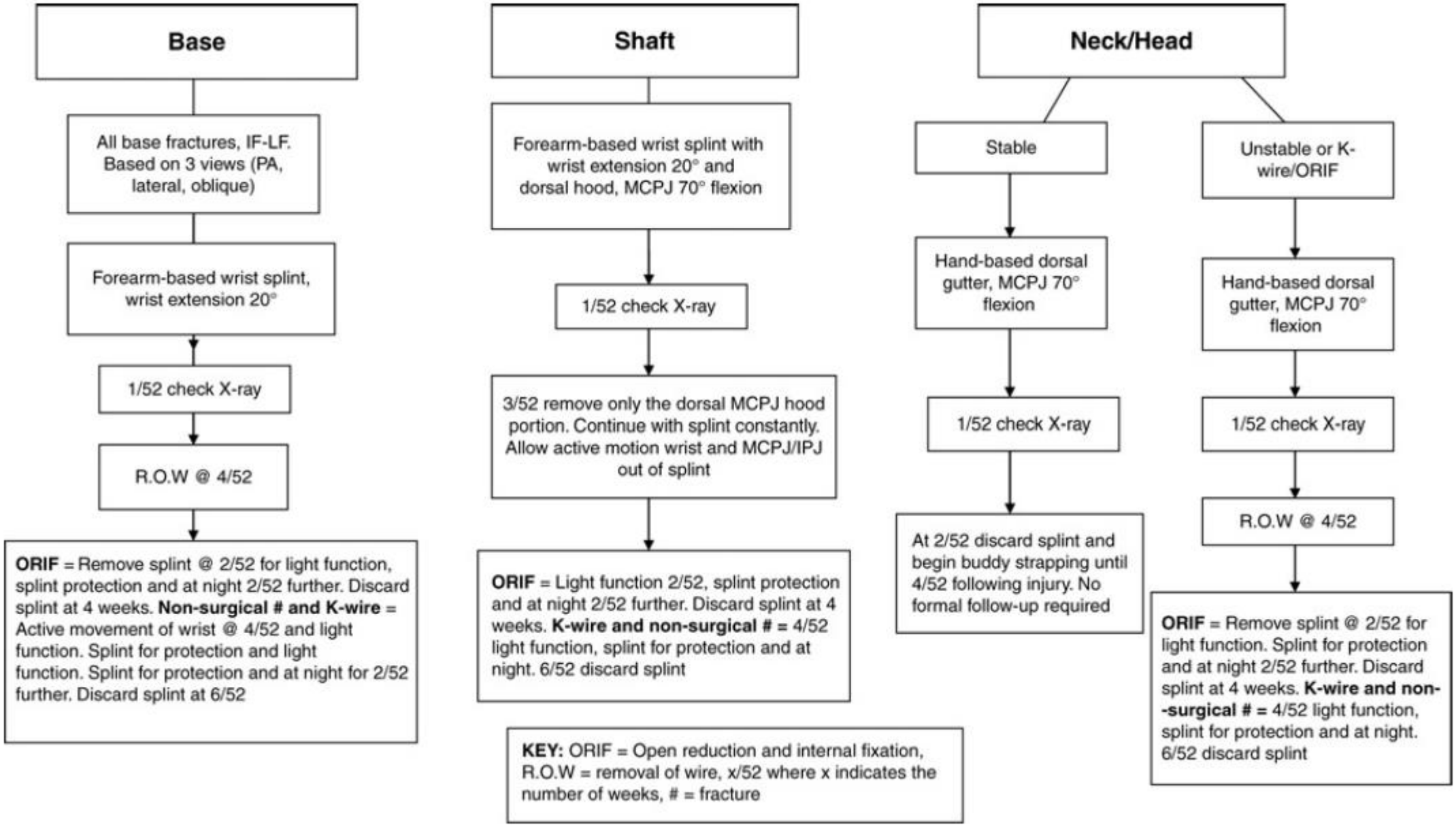
Base: cast or splint wrist 20º extension 4/52

- most common is 5th MC ‘reverse Bennett’ pull of ECU, often K-wired

Shaft: forearm based splint, wrist 15-20º ext, MCP 70º, AROM from 3-4/52

Neck/Head

- hand based splint, MCP 70º flexion
- MCP collateral ligaments taut in flexion
- Discard splint at 2/52, buddy strap until 4/52 (Midgley and Toeman, 2011)
- Immobilised 3-4/52 (McNemar, 2003)



Midgley and Toeman, 2011

FIGURE 6. A 3-point fixation splint to treat a stable metacarpal shaft fracture. One pressure point is over the fracture apex and two counter pressure points are on the proximal and distal palmar surface of the metacarpal.

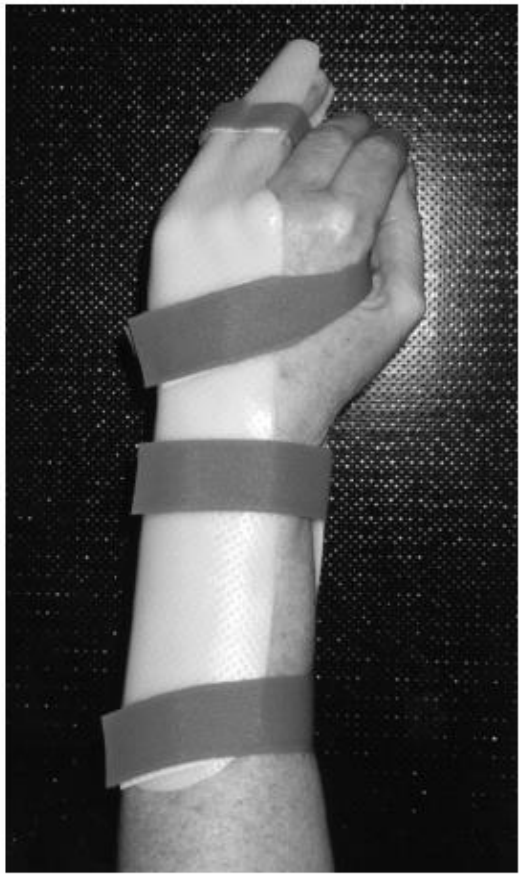


FIGURE 3. Forearm-hand based ulnar gutter custom splint that includes neighbor border digit.

McNemar, 2003

Metacarpal fracture complications

MC shortening
- pseudo-claw
- extensor lag

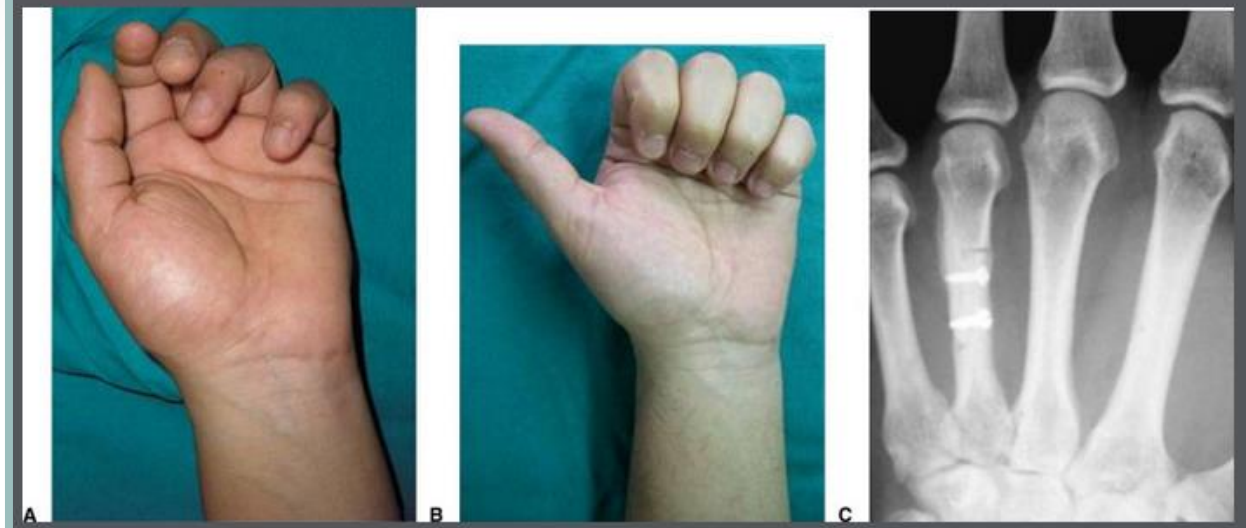
Malrotation
- Scissoring

MCP extension contracture
- tight collateral ligament
- intrinsic minus hand

Angulation malunion
- loss of MC prominence
- painful / weaker grip
- reduced efficiency of interosseous
- wedge osteotomy to correct

EDC adherence to fracture
- limiting MCP flexion

(Hardy, 2004; McNemar, 2003)



IMAGE

Modified Step-Cut Osteotomy for Metacarpal and Phalangeal Rotational Deformity

Journal of Hand Surgery.

Jawa, Andrew, MD; Zucchini, Maura, MD... Show all.. Published February 1, 2009. Volume 34, Issue 2. Pages 335-340. © 2009.

FIGURE 3 A Preoperative scissoring deformity of the ring finger from malunion of a metacarpal fracture. B Postoperative correction of the deformity by a modified step-cut osteotomy. C Postoperative radiograph with 2 lag screws for fixation of the osteotomy site.

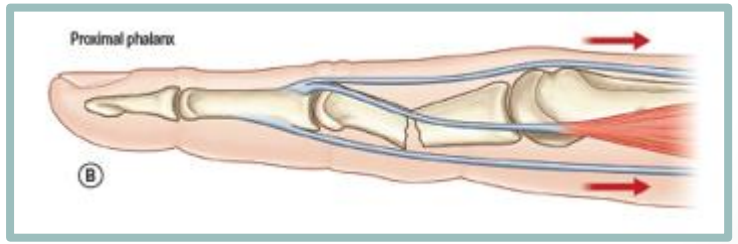
Conventional Radiographic Evaluation of Athletic Injuries to the Hand

Radiologic Clinics of North America.

Sundaram, Narayan, MD, MBA; Bosley, Jacob, MD; Stacy, Gregory Scott, MD.. Published March 1, 2013. Volume 51, Issue 2. Pages 239-255. © 2013.

Proximal phalangeal (P1) fractures

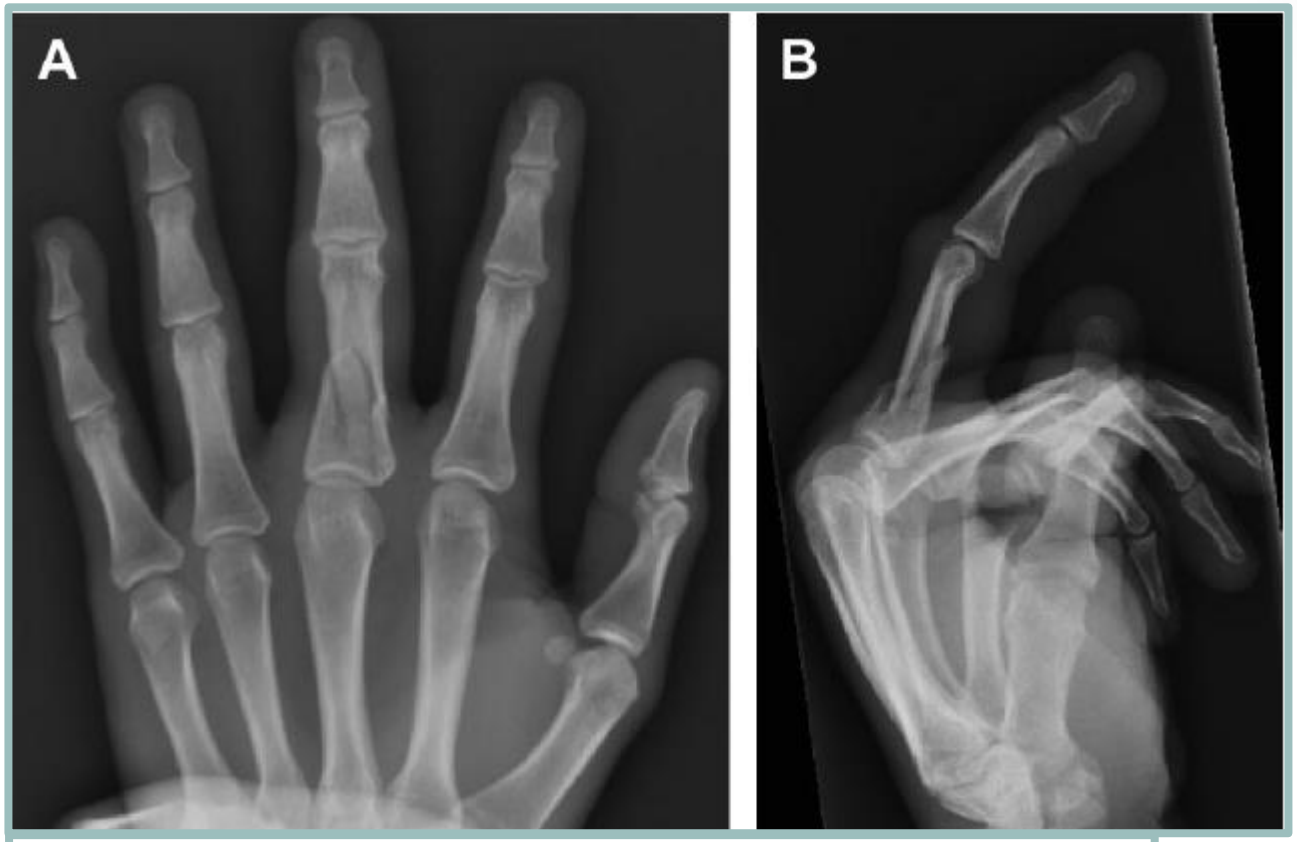
- Intra or extra-articular, transverse/longitudinal, oblique
- Volar apex; angulation
  - >25º may limit finger flexion
  - > 15º angulation → extensor lag due to relatively longer extensor mechanism; 12º for every mm of bone-tendon discrepancy (Freeland 2003)
- More unstable than MC fractures due to lack of intrinsic support and deforming forces of long tendons
- Respond poorly to immobilisation
- Managed with ORIF, k-wires, traction splints



Typical volar angulation of p1 fracture (Hammert, 2013)

FIGURE 4. A closed, slightly displaced unstable intra-articular fracture at the base of the proximal phalanx is treated with closed reduction and percutaneous mini-screw fixation.

Freeland, 2003



Comminuted extra-articular P1 fracture with typical volar apex displacement
Cotterell, 2015

Complications

- Malunion
  - rotation, angulation
- PIP extensor lag
- Tendon adherence
- Persistent oedema
- Loss of PIP flexion
- Loss of DIPJ flexion/extension
- Swan neck / boutonniere
- Poor functional outcomes
- Stiff finger!

Atrophic non-union P1 fracture
(Day & Stern, 2005)

Fractures in flexor zone 2 difficult to regain full ROM

90% of bone's surface covered by gliding structures

Fractures are often k-wire or ORIFed allowing early AROM but compounding soft tissue disruption

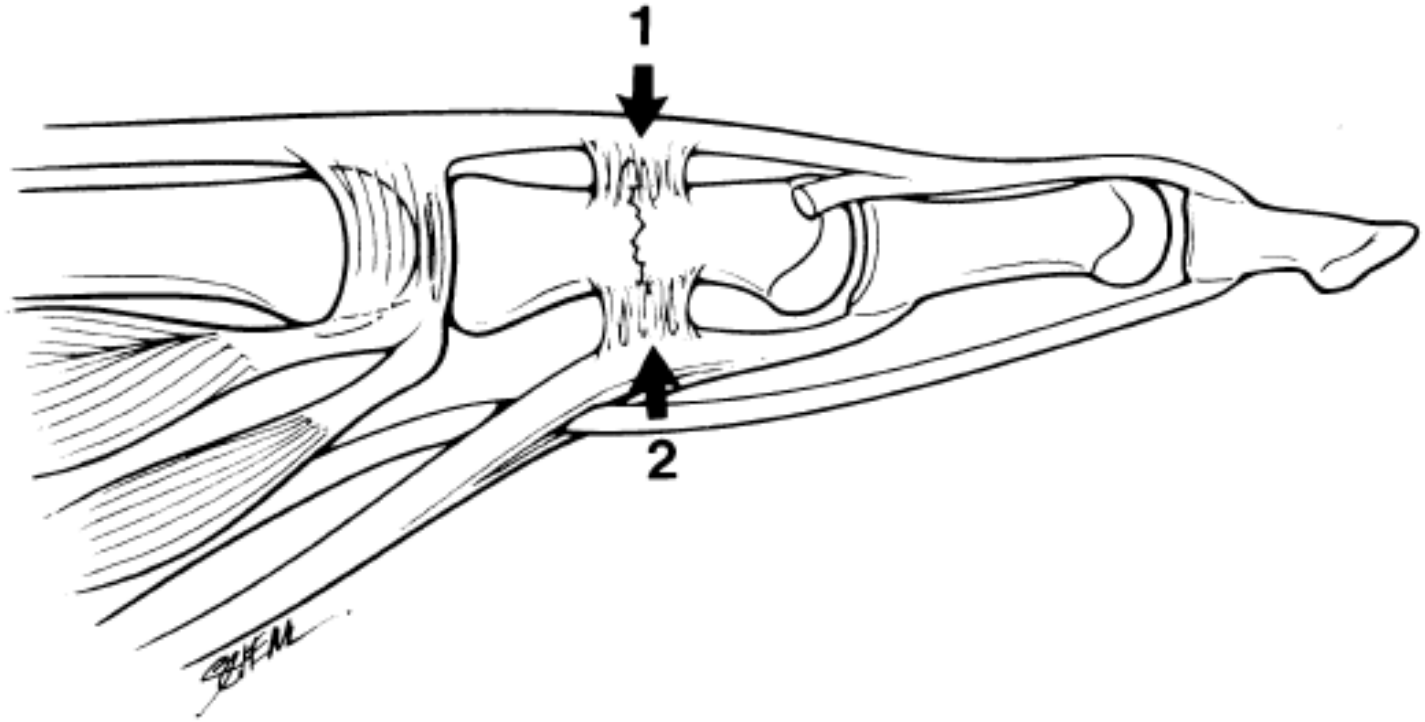


*FIGURE 1. Extensor tendon adhesions (**arrow 1**), flexor tendon adhesions (**arrow 2**), or both may form adjacent to a proximal phalanx fracture.*

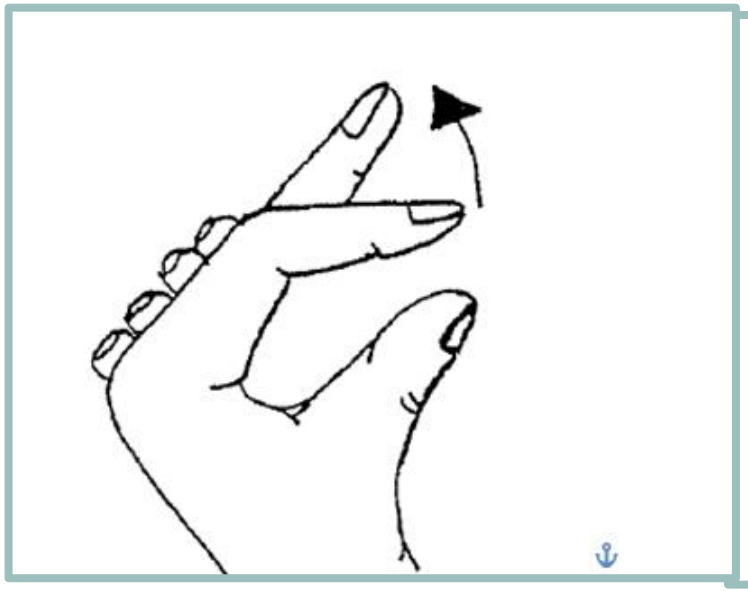
Freeland 2003

P1 fracture management

- Hand based or finger based splint; MCP 70º flexion, IP extended
  - correct positioning of PIP helps prevent FFD
- Mobilise as soon as fracture is stable
  - TGEs for flexors and extensors
  - early central slip and lateral band exercises
  - relative motion splint for PIP extension
- Stable non-displaced fracture may be buddy-taped to adjacent finger
- Consider forearm based splint with wrist in flexion
  - Increases tension on extensor mechanism
  - Relaxes tension on long flexors

Fig. 3. Buddy straps or buddy tape allows the neighboring digit to act as a splint that provides support but allows early motion.

Carpenter, 2013



Block MCPJs or use yoke splint or pencil to facilitate PIP extension

Intra-articular PIPJ

- Often unstable, problematic to mobilise
- Painful
- Significant oedema
- Multiple soft tissue structures involved
- Poor outcomes if immobilised

- Managed with ORIF, traction splints, hemi-hamate arthroplasty
- Volar plate: dorsal blocking splint

Intra-articular PIPJ fractures

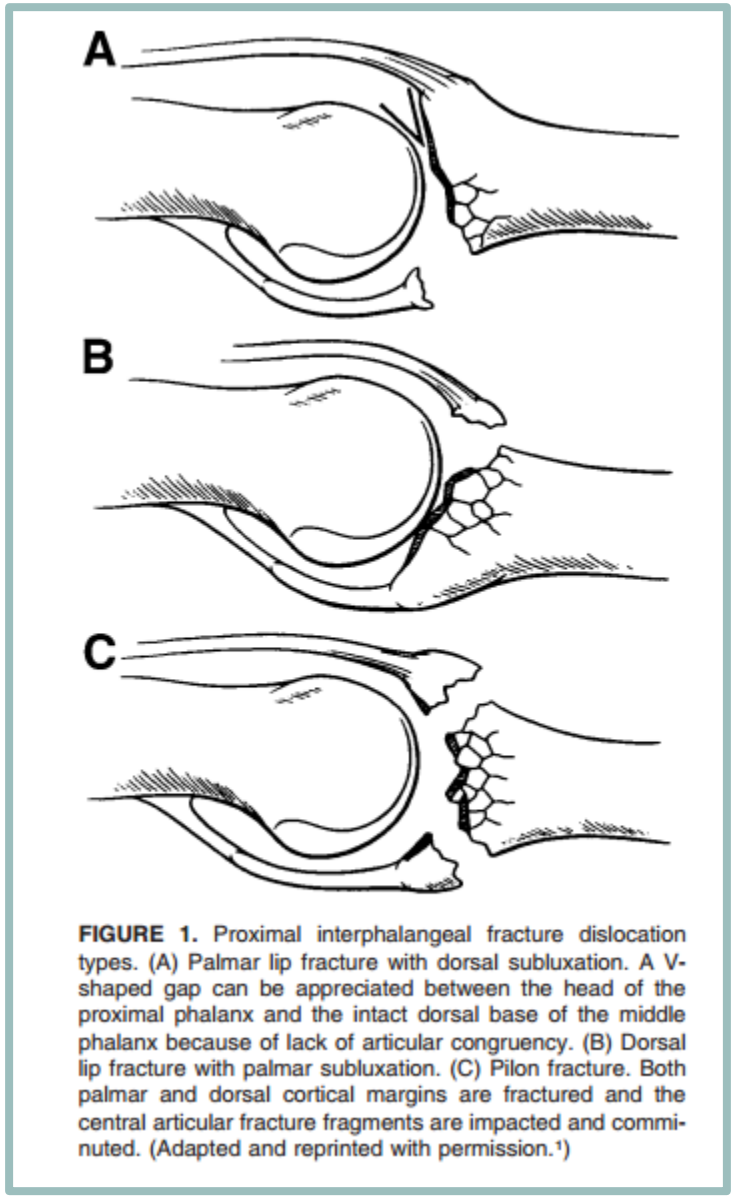


FIGURE 1. Proximal interphalangeal fracture dislocation types. (A) Palmar lip fracture with dorsal subluxation. A V-shaped gap can be appreciated between the head of the proximal phalanx and the intact dorsal base of the middle phalanx because of lack of articular congruency. (B) Dorsal lip fracture with palmar subluxation. (C) Pilon fracture. Both palmar and dorsal cortical margins are fractured and the central articular fracture fragments are impacted and comminuted. (Adapted and reprinted with permission.[1])

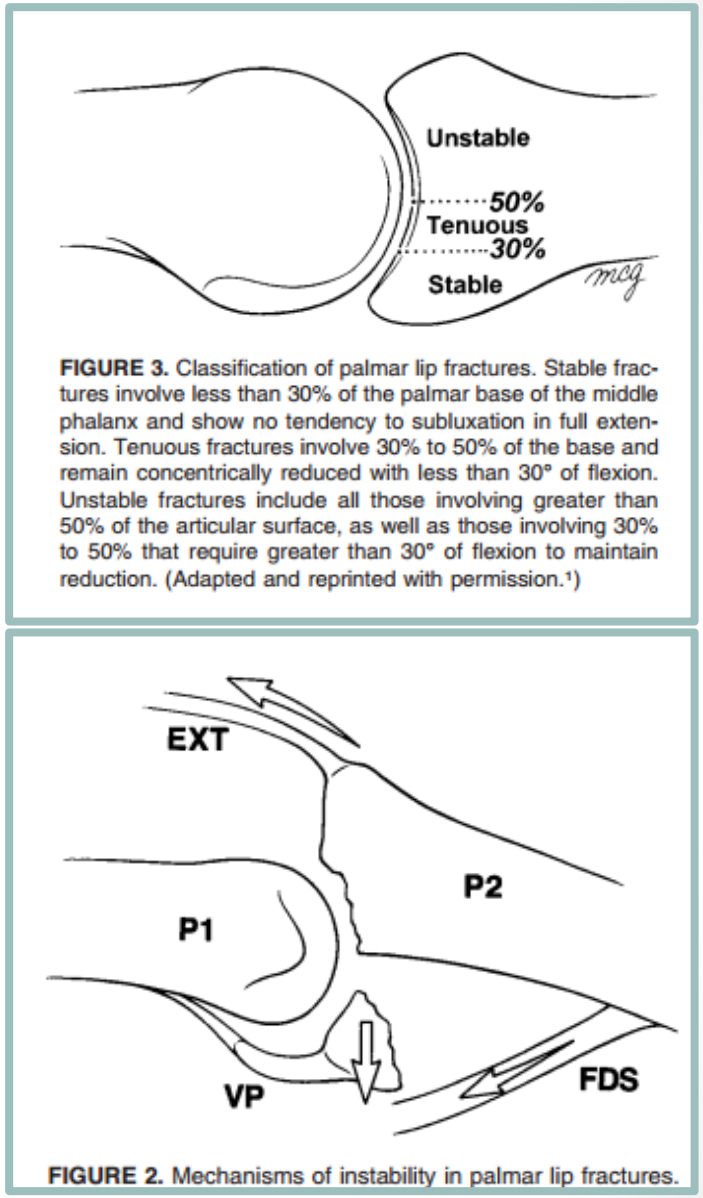


FIGURE 3. Classification of palmar lip fractures. Stable fractures involve less than 30% of the palmar base of the middle phalanx and show no tendency to subluxation in full extension. Tenuous fractures involve 30% to 50% of the base and remain concentrically reduced with less than 30° of flexion. Unstable fractures include all those involving greater than 50% of the articular surface, as well as those involving 30% to 50% that require greater than 30° of flexion to maintain reduction. (Adapted and reprinted with permission.[1])

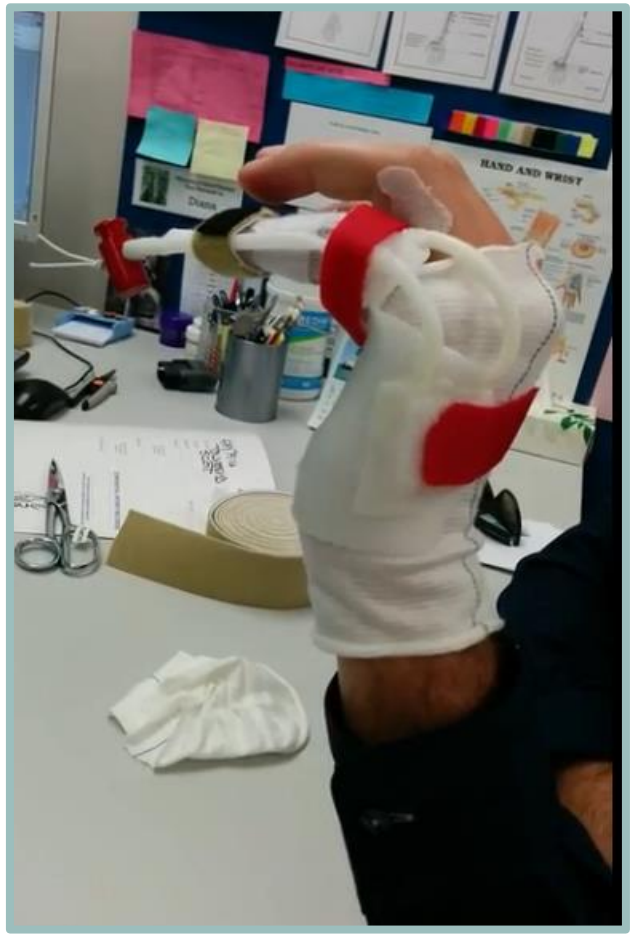
FIGURE 2. Mechanisms of instability in palmar lip fractures.

Kang & Stern, 2002

Dorsal splint for volar plate avulsion fracture; allows active flexion exercises while maintaining reduction of frature
(Carpenter, 2013)

FIGURE 9. Cast for central slip avulsion fracture that maintains full proximal interphalangeal joint extension while allowing active distal interphalangeal joint flexion to maintain the length of oblique lateral ligaments and lateral bands.

Hardy, 2004



Dynamic traction splint for PIP fracture

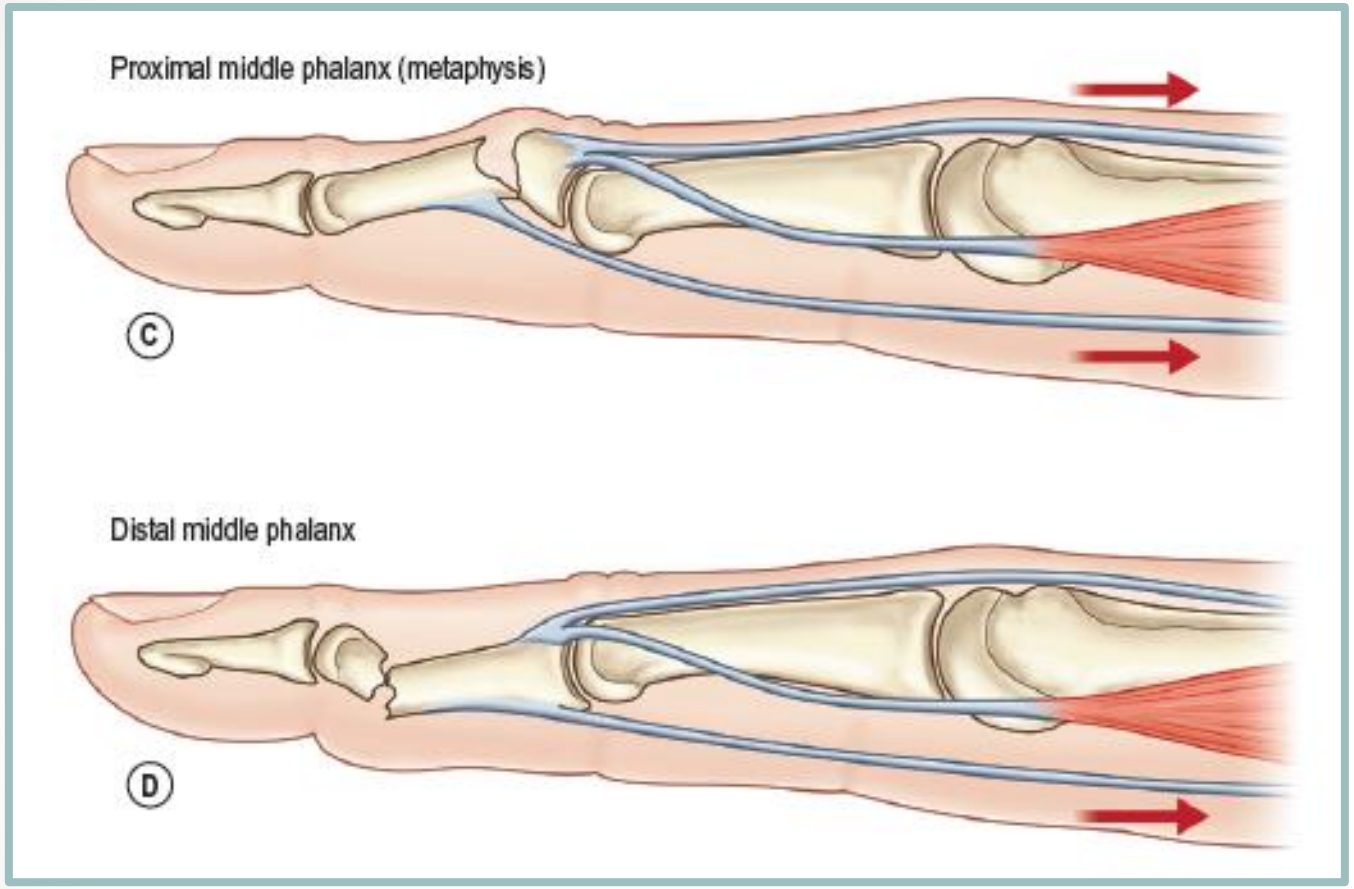


Fig. 7.1 Angular deformity associated with fractures of the metacarpal and phalanges. **(A)** Metacarpal fractures typically have apex dorsal angulation secondary to the location of the interosseous muscles while the proximal phalanx fractures **(B)** have an apex volar angulation. The angulation of middle phalanx fractures is dependent o the location of the fracture, relative to the insertion of the FDS tendon: fractures proximal to the insertion **(C)** will have apex dorsal angulation while those distal **(D)** will have apex volar angulation.

Middle phalanx fractures

- Longer healing time for shaft fracture
- Skeletal shortening can cause DIP extensor lag

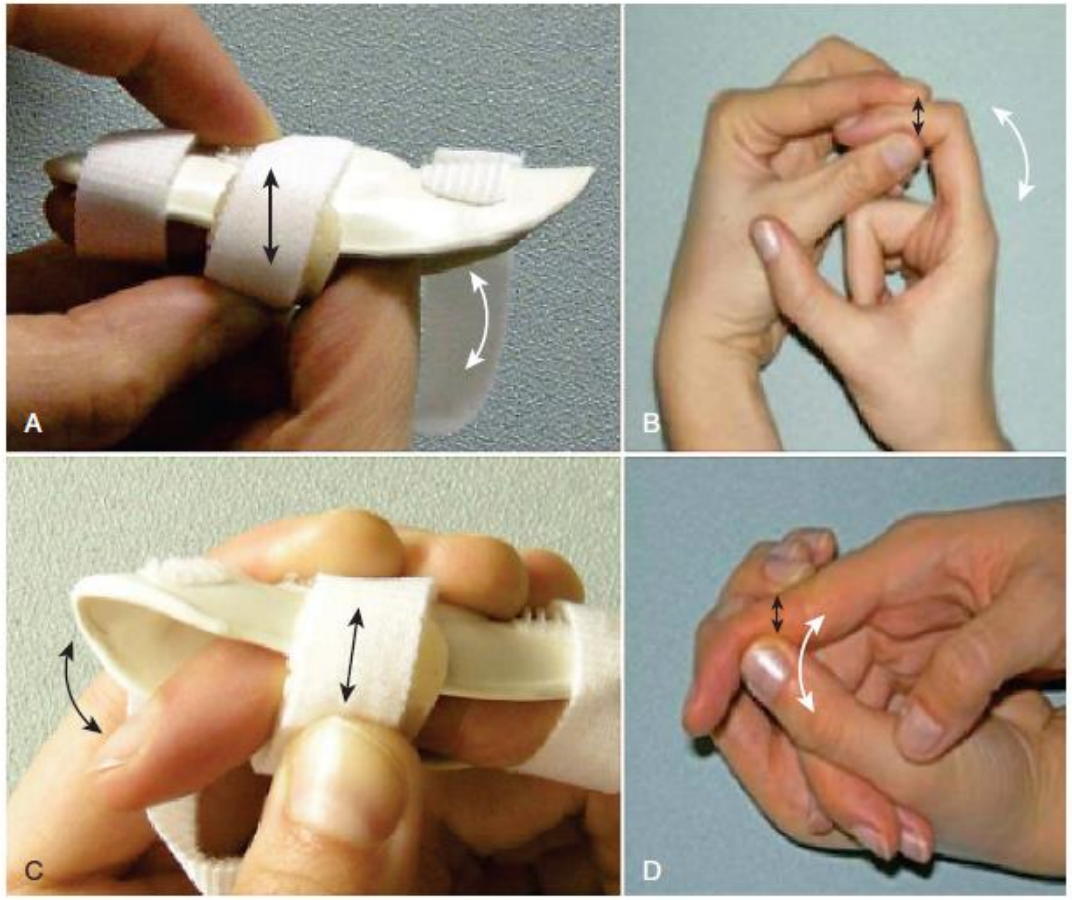


Figure 31-10 Middle phalangeal (P2) fracture: Stabilized tendon-gliding exercises. **A** and **B,** Stabilized, passive proximal interphalangeal flexion and extension (**A,** in orthosis; **B,** out of orthosis). **C** and **D,** Stabilized, active blocked distal interphalangeal flexion and extension. (**C,** in orthosis; **D,** out of orthosis).

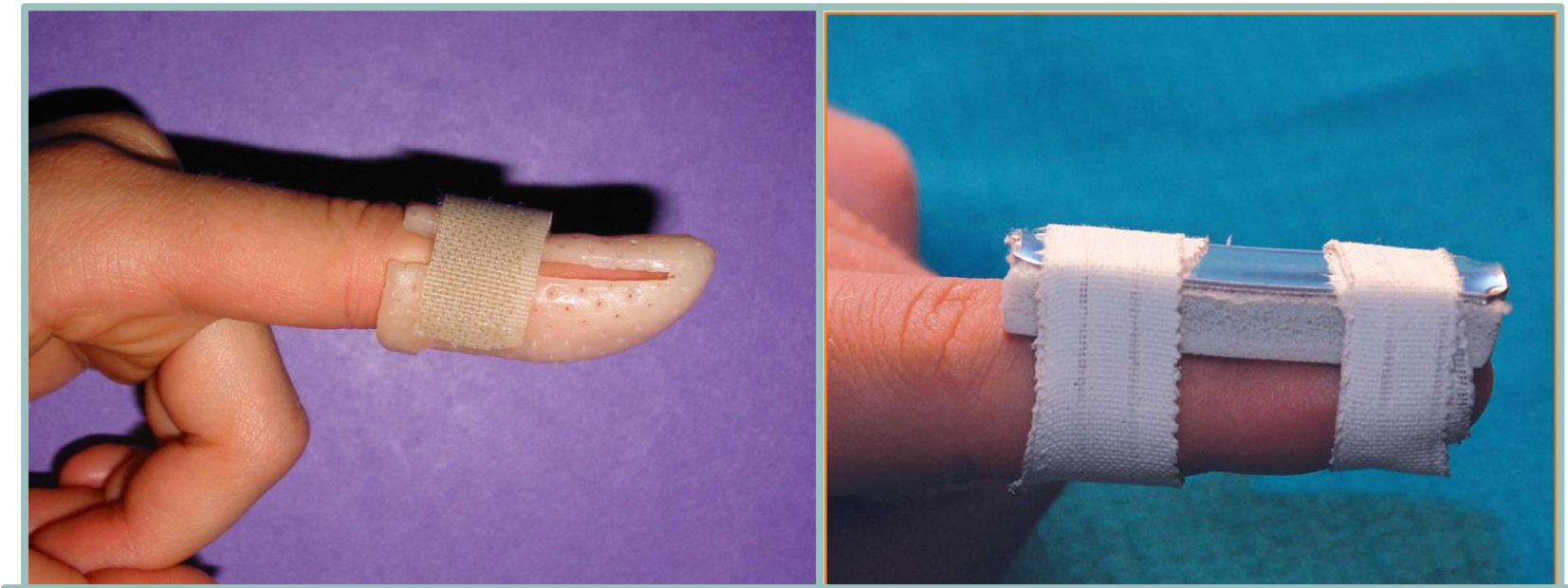
Example of early protected mobilisation for middle phalanx fracture (Feehan, 2011)

Distal phalanx fractures

- Crush injuries
- Nail bed
- Mallet fractures
  - terminal tendon avulses off dorsal base of distal phalanx
  - ORIF or conservative management
  - continuous immobilisation 6/52
  - at 6/52; graded wean from splint and progressive DIPJ ROM
  - avoid blocked DIPJ flexion initially to avoid stretch of ORL
- Tuft fractures
  - splint for comfort
  - fingertip hypersensitivity common
  - desensitization, protective sleeve to ‘dampen’ painful sensory input

Differential diagnosis

- 17yr old male
- 4/52 post rugby injury, finger forced against thigh of another player
- No immobilisation from time of injury; buddy taped intermittently
- Slightly tender radial base distal phalanx
- Mild swelling/redness dorsal/radial
- 20 degree DIP extensor lag
- Full flexion



Thumb fractures

Bennett fracture

- Single fragment displaced by anterior oblique ligament
- MC subluxed by APL
- Reduced by traction, thumb pronation and adduction of MC base
- usually K-wired or ORIF
- immobilised 4-6/52 or early AROM if ORIFed (Diaz-Garcia, 2013; McNemar, 2003)

Rolando

- Comminuted intra-articular base 1st MC #: often T or Y shaped

Metacarpal shaft, UCL or RCL avulsion #, proximal or distal phalanx #s

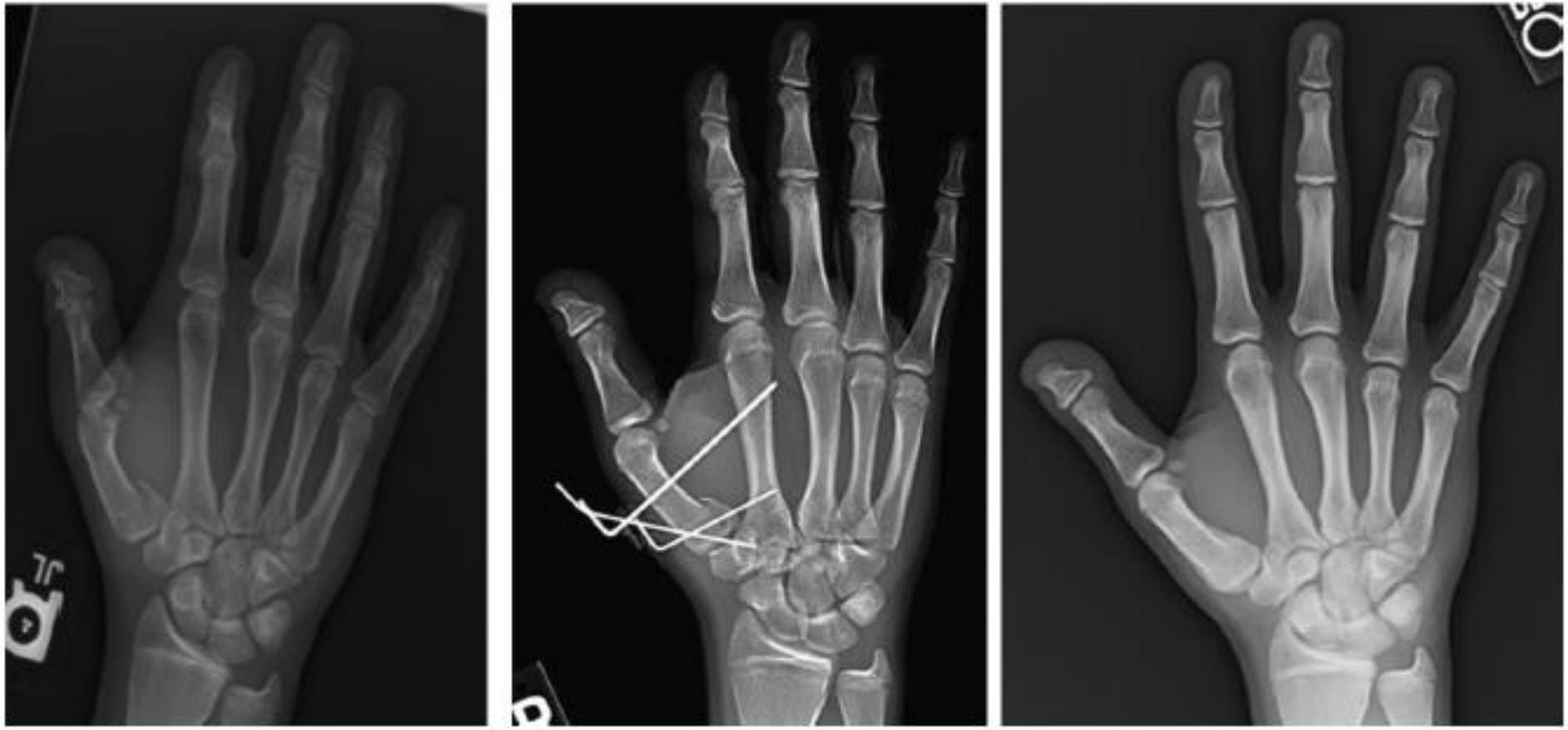
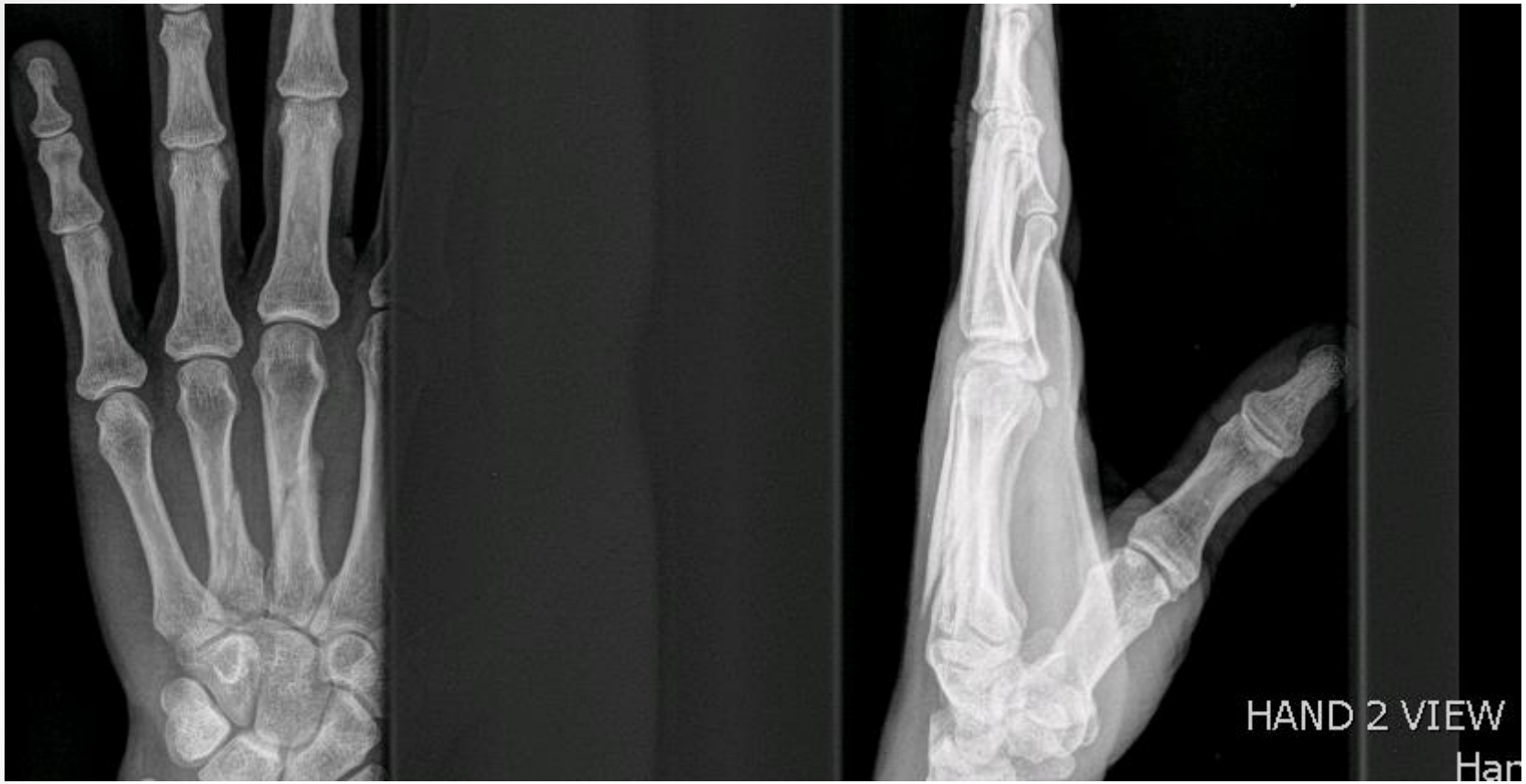


Fig. 7. Closed reduction and K-wire fixation of a fracture of thumb metacarpal base. (*A*) Preoperative. (*B*) Postoperative.

Bennett fracture, (Diaz-Garcia, 2013)



30th June

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