Hand
Important Fracture dislocation injuries

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Finger - PIP joint

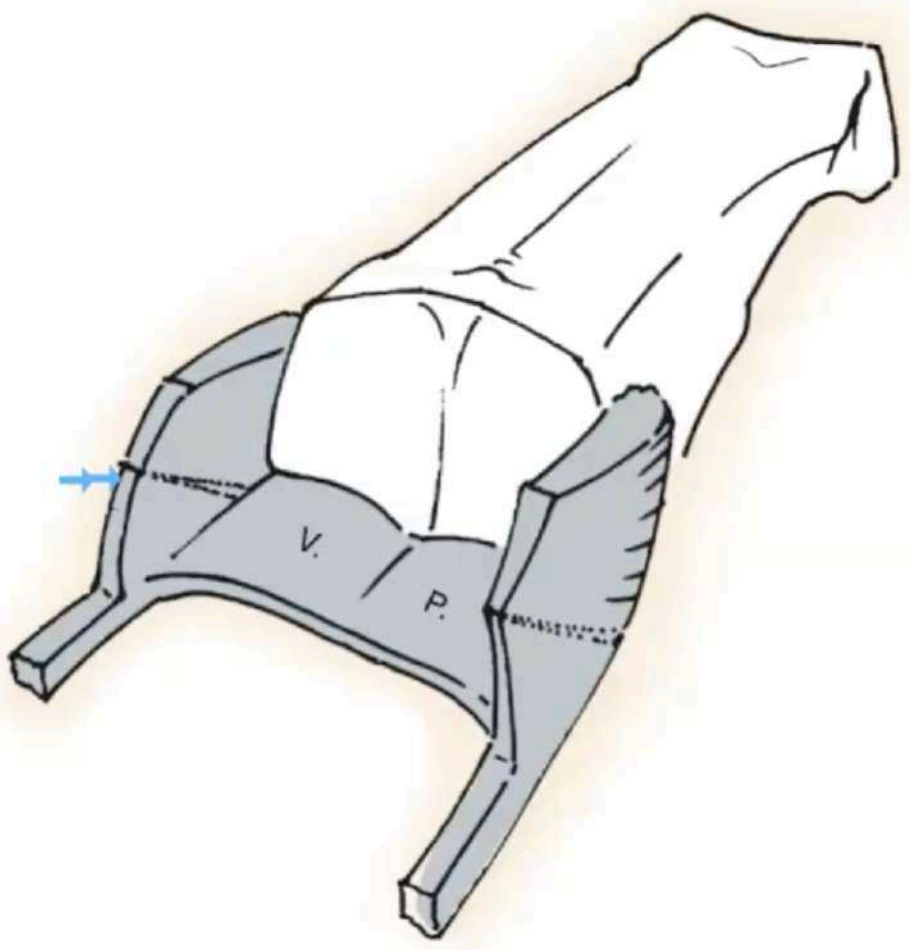


Figure 9.1 Three-dimensional ligament-box complex provides strength with minimal bulk. At least two sides of this box must be disrupted for displacement of the joint to occur.

Pip joint

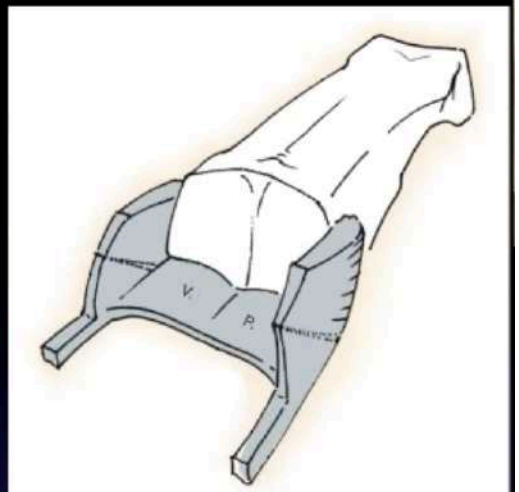


Figure 9.1 Three-dimensional ligament-box complex provides strength with minimal bulk. At least two sides of this box must be disrupted for displacement of the joint to occur.

- Slight Asymmetry of condyles imparts upto 9 degree of supination through complete arc of pip joint
- **Proper collateral ligament** [primary stabilizer - insert on volar 1/3 rd of base of Mpx
- Accessary collateral - insert on volar plate

Types - Pip joint dorsal dislocation

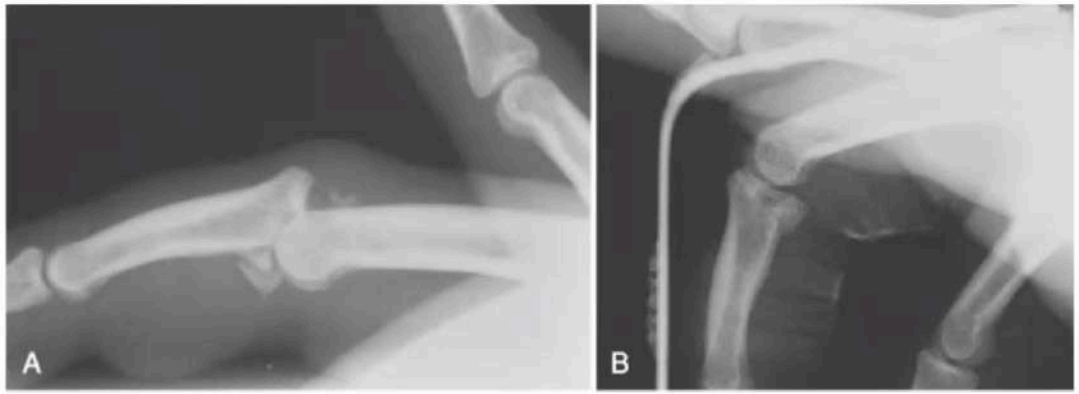


Figure 9.8 A, Type III fracture-dislocation of PIP joint in which approximately 40% of volar articular surface is displaced with fracture fragment. **B,** Fracture-dislocations with 40% or less of articular surface involved may be successfully treated with dorsal extension block splinting. The patient is allowed to actively flex PIP joint, which is progressively extended over approximately 4 weeks. The key to this mode of treatment is concentric reduction of PIP joint.

- **Type I** - hyper extension deformity with joint surface still touching
- **Type II**- bayonet position
- **Type III** - fracture dislocation

Grading of PIP joint Stability - Collateral ligament injury

- **Grade I**- pain but no laxity
- **Grade II**- laxity but firm endpoint , stable arc of motion
- **Grade III** - grossly unstable , no firm end point

PIP JOINT criteria of simple dorsal dislocation

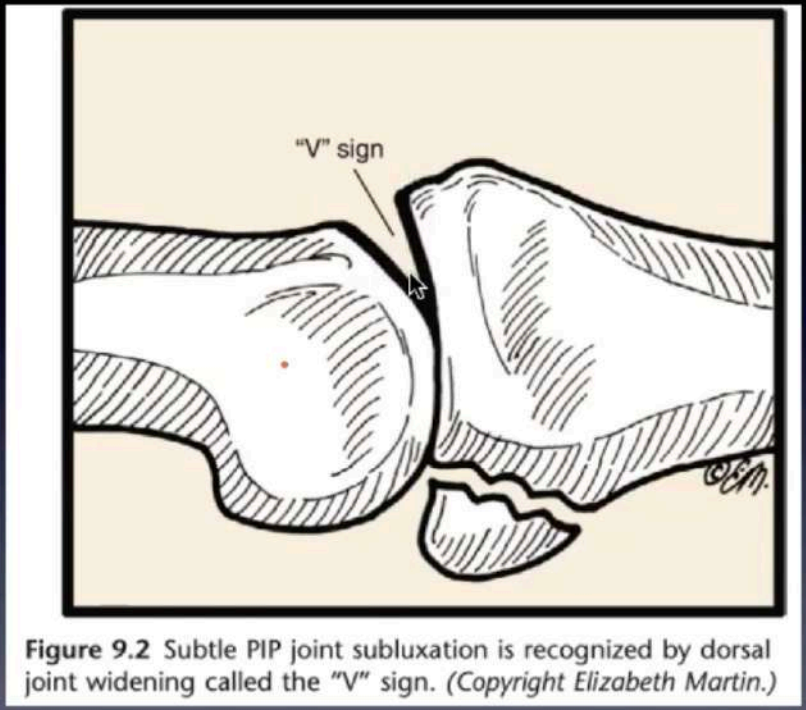


Figure 9.2 Subtle PIP joint subluxation is recognized by dorsal joint widening called the "V" sign. *(Copyright Elizabeth Martin.)*

- ARTICULAR CONGRUITY - concentric reduction
- STABILITY - less than 40 percent volar articular surface

Stable dorsal dislocation

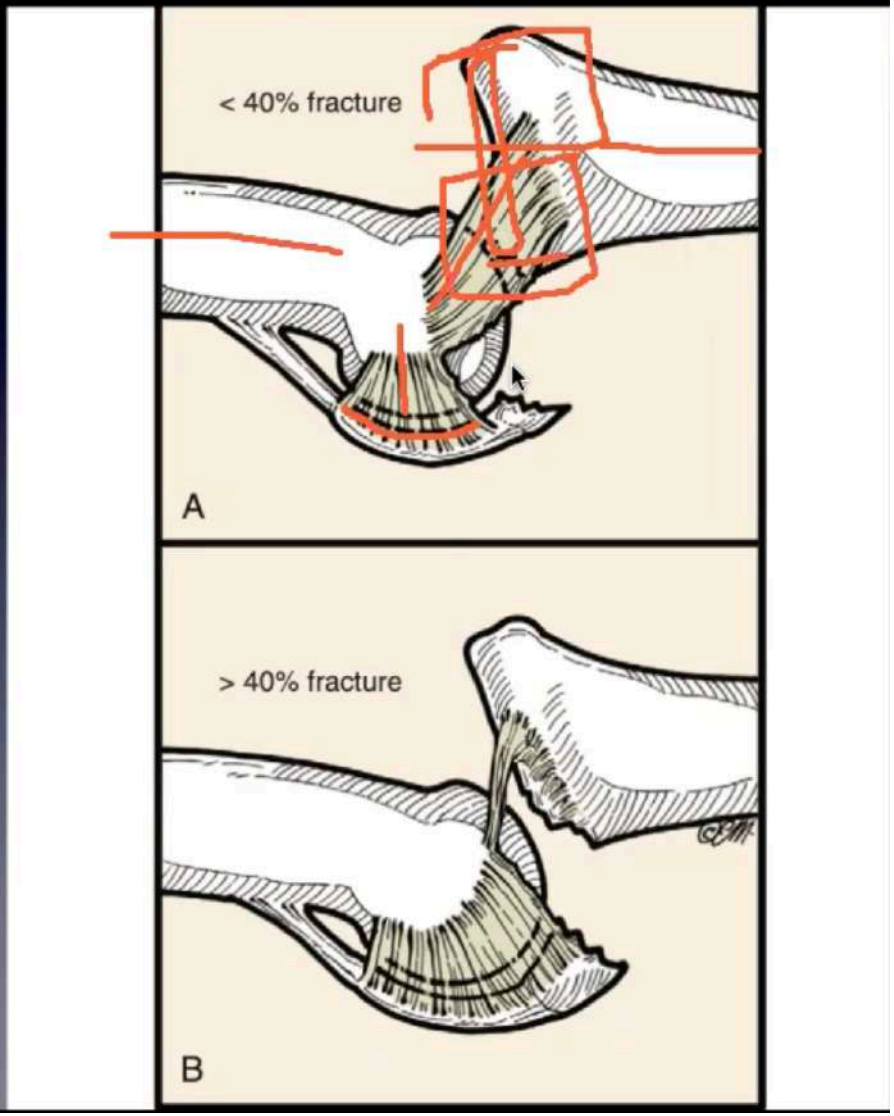
Disruption occurs through base of proximal phalanx rather at insertion of volar plate

Treatment - Dorsal block splint

- Fluoroscopy will determine how much extension possible while maintaining fracture and joint reduction
- 30 degree block is initiated with 10 degree of extension weekly

Unstable fracture dislocation

- >40 % articular surface involved - as one large fragment or communited



Pilon fracture

Figure 9.9 **A,** Anteroposterior radiograph of pilon PIP joint injury with distal extension, shortening, and subluxation. **B,** Lateral radiograph of same injury before traction. **C,** Lateral radiograph after reduction.

- Widening of base of middle phalanx as dorsal and volar fragment
- and more central cartilage surface are impacted into the cancellous bone

Types of operation for **Unstable** pip joint fracture dislocation and **Pilon** fracture

- Extension block pinning / splint
- ORIF
- Dynamic traction
- Hemihamate autografting
- Circle wiring
- Volar plate arthroplasty

Extension block splint -Indication

- No articular incongruity
- Collateral ligament - retained to Mpx
- Reduction achieved in no more than 30 degree of flexion
- If splint applied in more 30 degree flexion than risk of late flexion contracture
- Short small swelling finger - splint compliance is not present

Extension block pinning - Indication

- short small finger with PIP dislocation
- Pin placed in head of Ppx at an angle and obliquely between central tendon and lateral band to allow gentle active motion

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Extension block pinning - Indication

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Dynamic skeletal traction -Indication

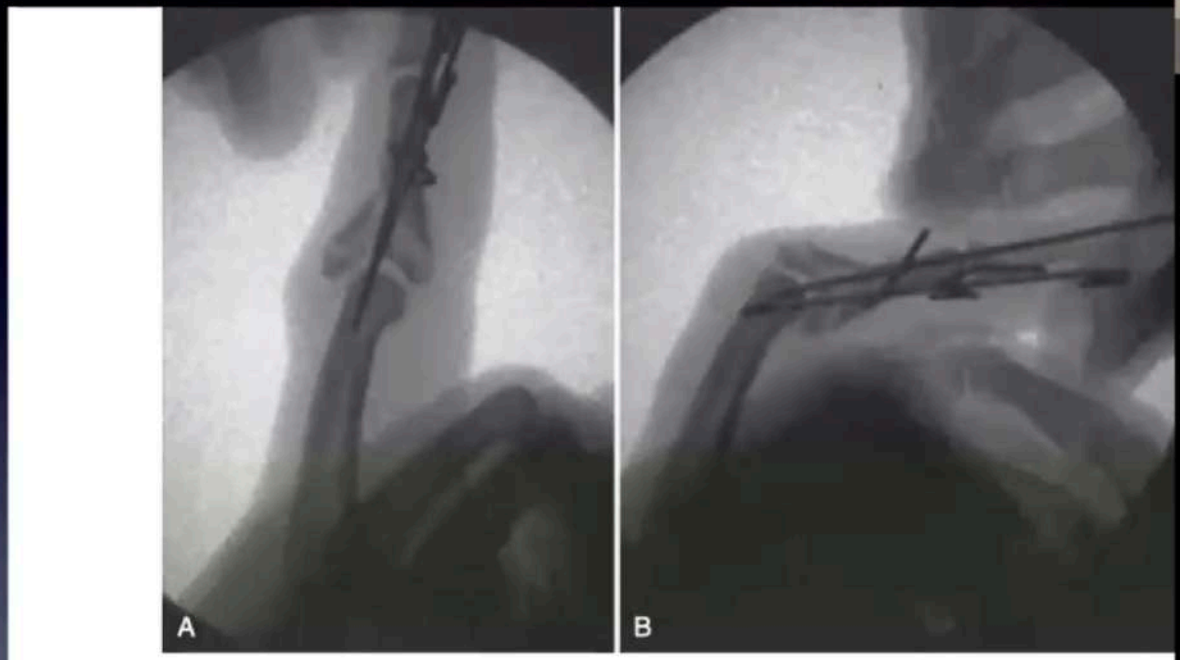


Figure 9.14 Full extension is typically the most unstable position. **A,** Lateral radiograph shows some overall widenii at joint, but no subluxation or secondary incongruity. **B,** Lateral view with joint flexed also shows congruity.

- Pilon fracture
- Multiple small fragments involving 30 to 50 % articular surface
- Maintain reduction while allowing motion and neutralise joint reaction force minimise settling of small articular fragments

ORIF - Indication

- Single large fragment

Hemihamate arthroplasty - introduced by Hasting

- Dorsal and distal aspect of Hamate centering over 4th and th cmc joint
- Approximately 1/2 of each in volar - dorsal and radio -ulnar planes
- Better than volar plate arthroplasty

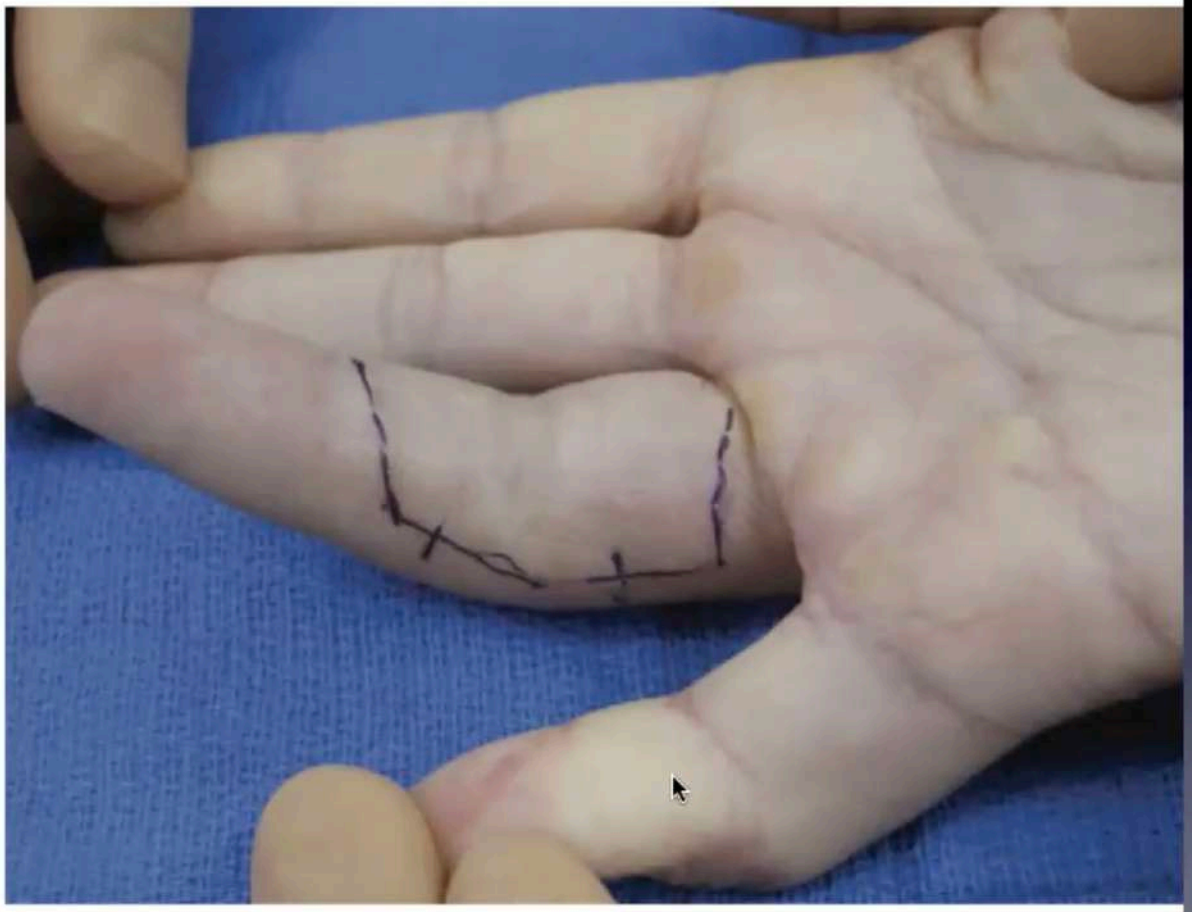


Figure 9.19 Incision for hemihamate arthroplasty extends obliquely proximally and distally, but continues along mid-axial line at PIP joint to maximize exposure. *(Courtesy Hill Hastings, MD.)*

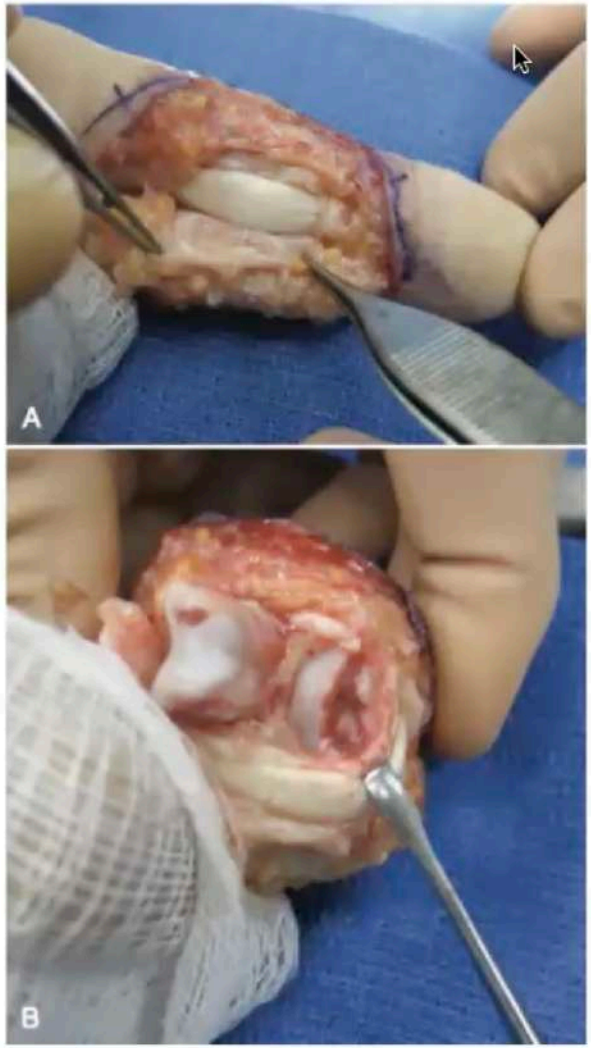


Figure 9.20 A, Flexor sheath between A2 and A4 pulleys is incised along one edge and elevated. Later it will be passed under the tendon to prevent adhesions at repair site. **B,** After recession of collaterals, joint can be "shotgunned" open. *(Courtesy Hill Hastings, MD.)*

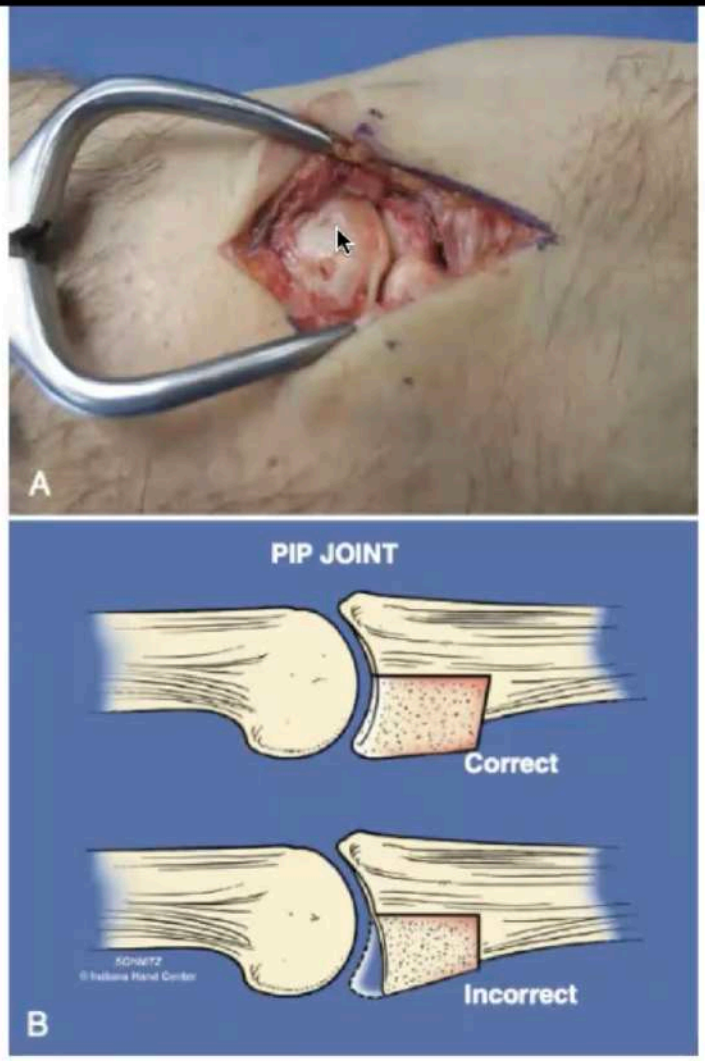
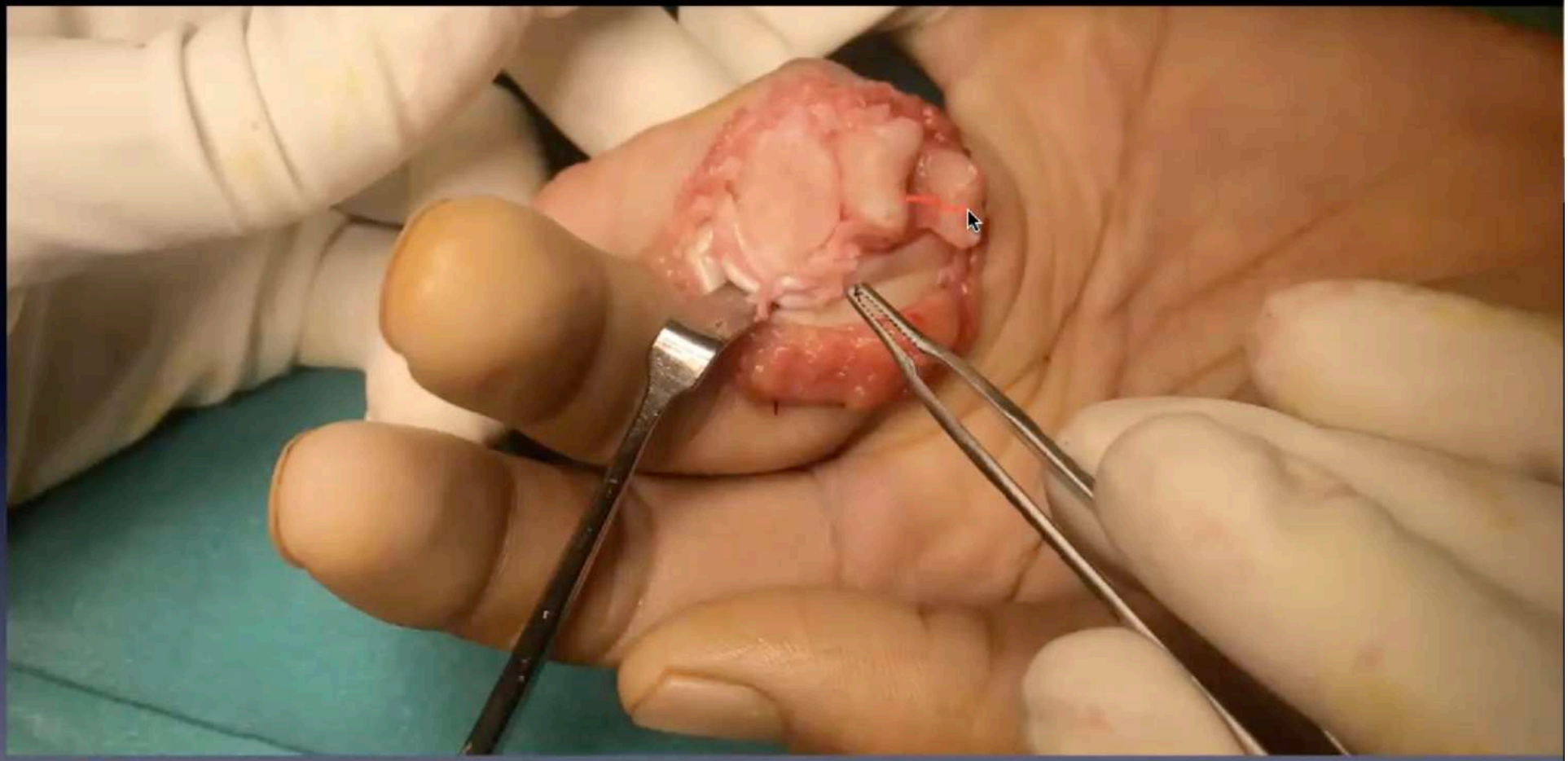
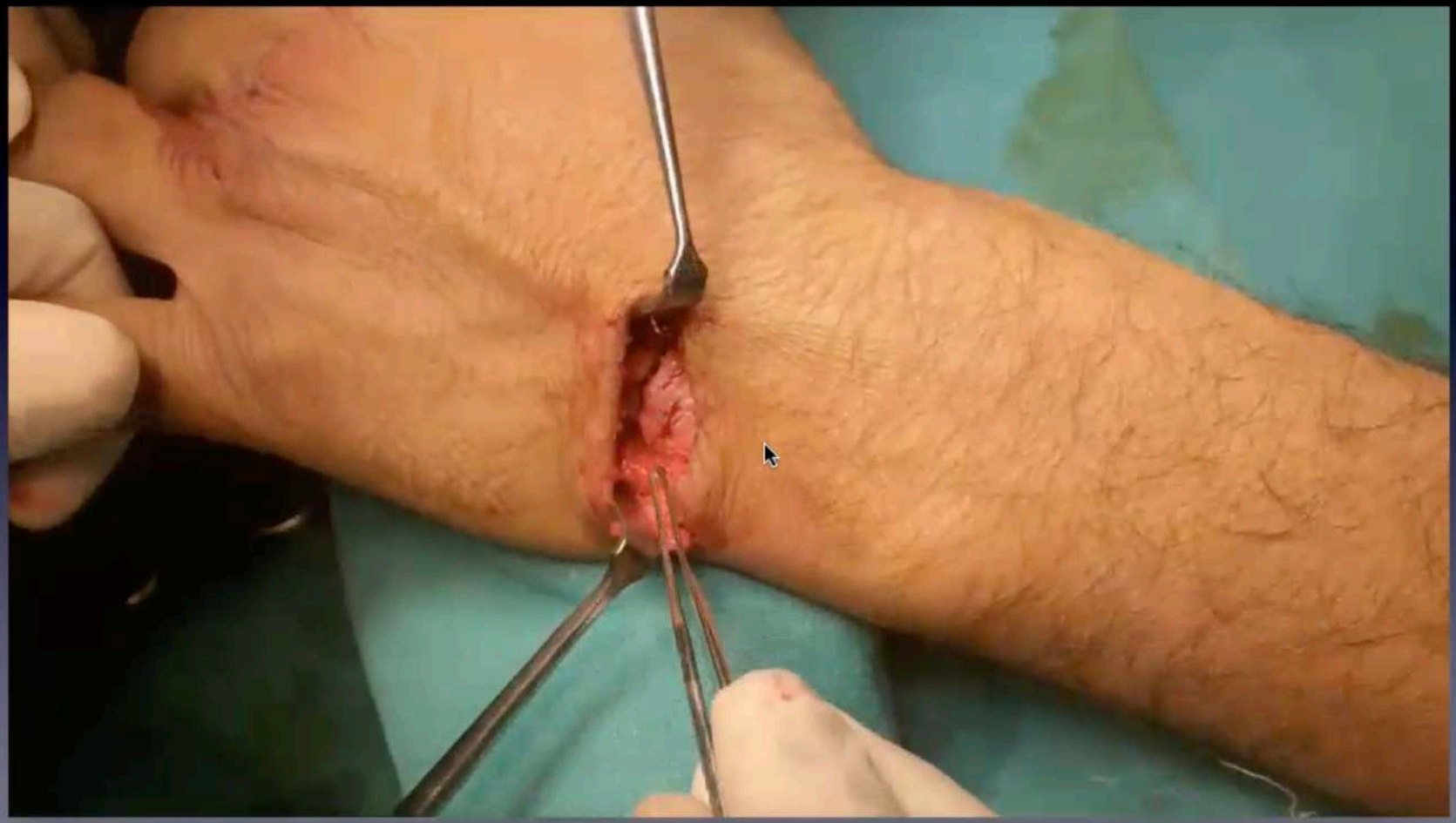
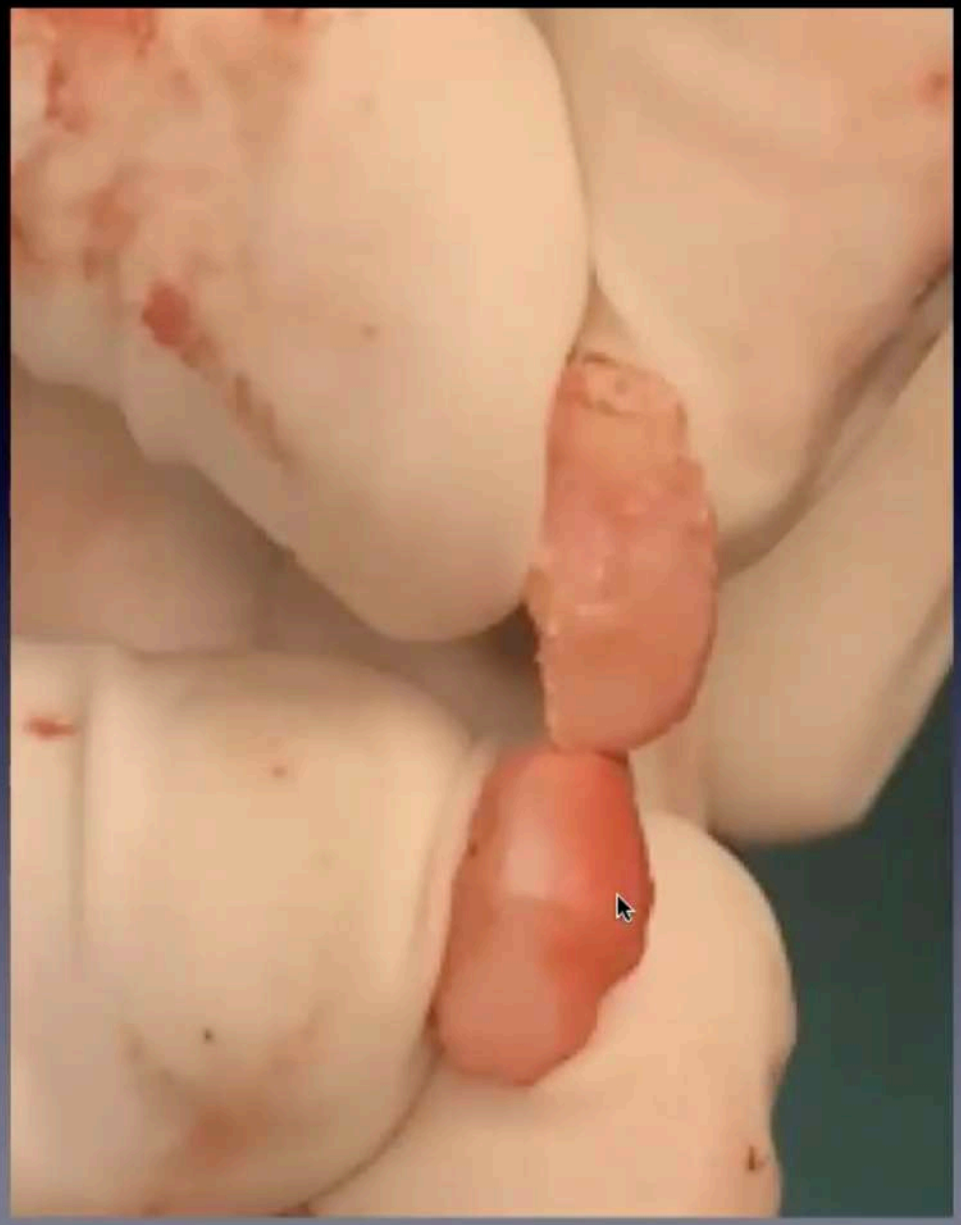
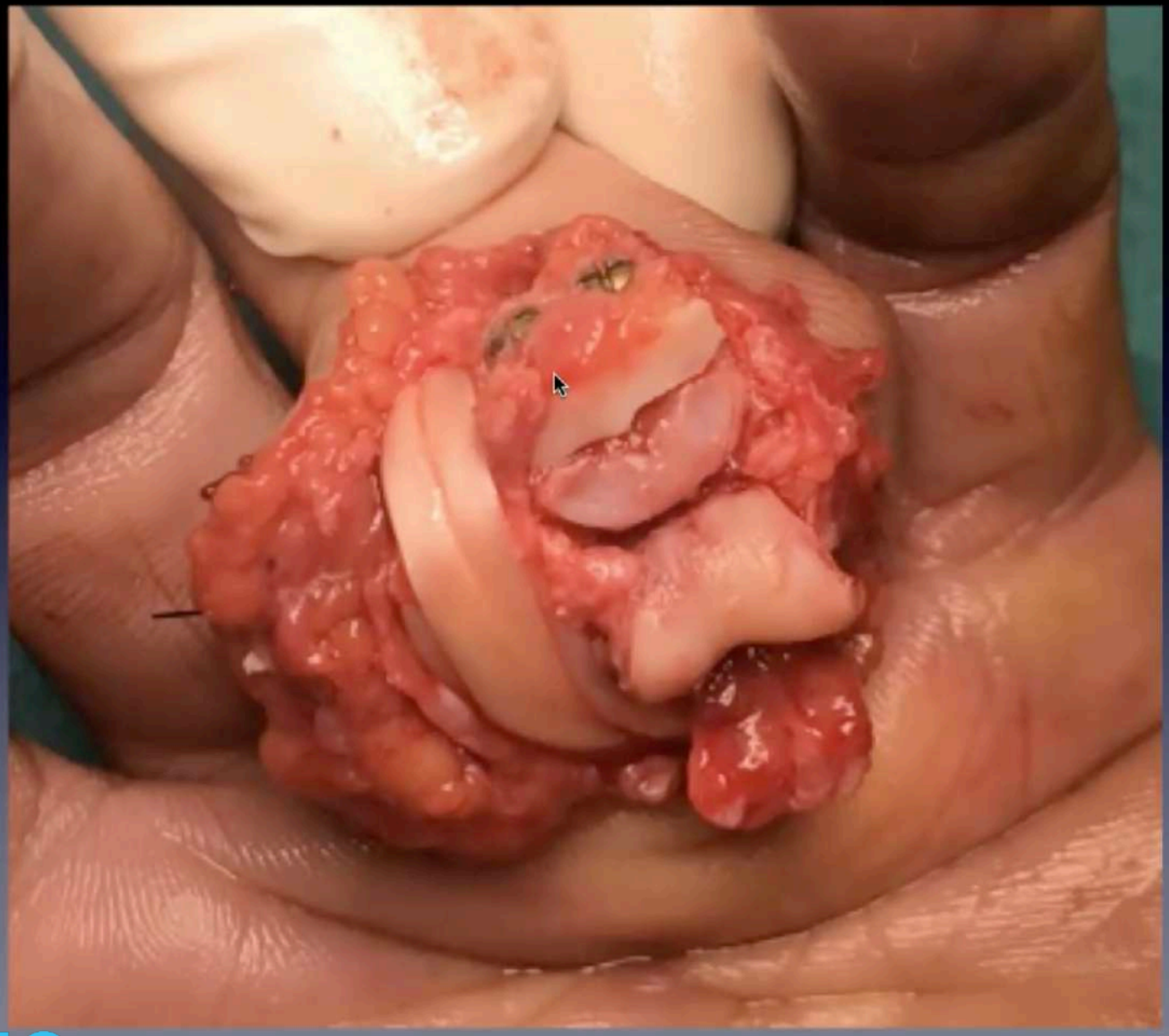


Figure 9.22 **A,** Dorsal articulation of hamate and fourth and fifth metacarpal articulation is exposed. **B,** Graft is planned to be shaped such that when in place it tilts to recreate volar lip. *A, Courtesy Hill Hastings, MD. B, From* Master Techniques in Orthopaedic Surgery: The Hand, *2nd ed, Philadelphia, Lippincott*









Post op -PIP in flexion

Circlage wiring - Indication

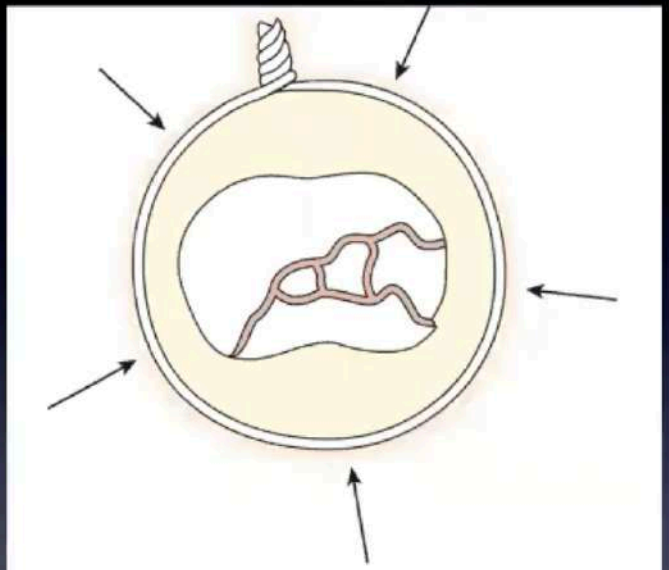


Figure 9.17 After shotgun exposure of joint, fragments are managed with elevation and bone graft as needed. Cerclage wire is passed around proximal end of phalanx preventing typical dorsal/volar expansion in pilon-type injuries and holds small fragments that may not be amenable to individual fixation in place. *(Technique courtesy of Dr. A.P.C. Weiss. From Weiss AP: Cerclage fixation for fracture dislocation of the PIP joint,* Clin Orthop Relat Res *[327]:21-28, 1996.)*

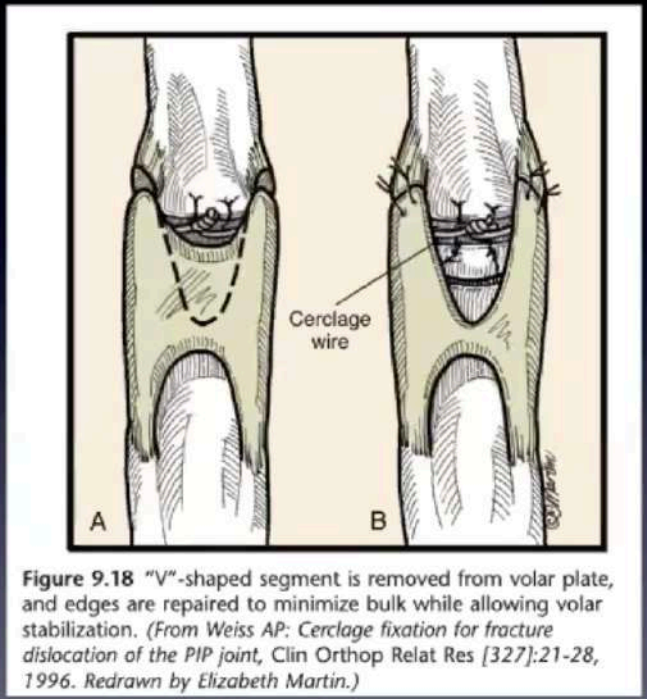


Figure 9.18 "V"-shaped segment is removed from volar plate, and edges are repaired to minimize bulk while allowing volar stabilization. *(From Weiss AP: Cerclage fixation for fracture dislocation of the PIP joint,* Clin Orthop Relat Res *[327]:21-28, 1996. Redrawn by Elizabeth Martin.)*

- Minimum joint subluxation but significant articular com munition

Volar plate arthroplasty

- Defect in volar rim of middle phalanx is shaped perpendicular into transverse groove perpendicular to long axis of phalanx
- Interval between volar plate and collateral ligament incised and fibrocartigae plate is mobilised to advance 4-6 mm distally into the defect of Mpx
-

Volar plate arthroplasty

- In old case - Step cut release the proximal checkrein ligaments to gain sufficient length

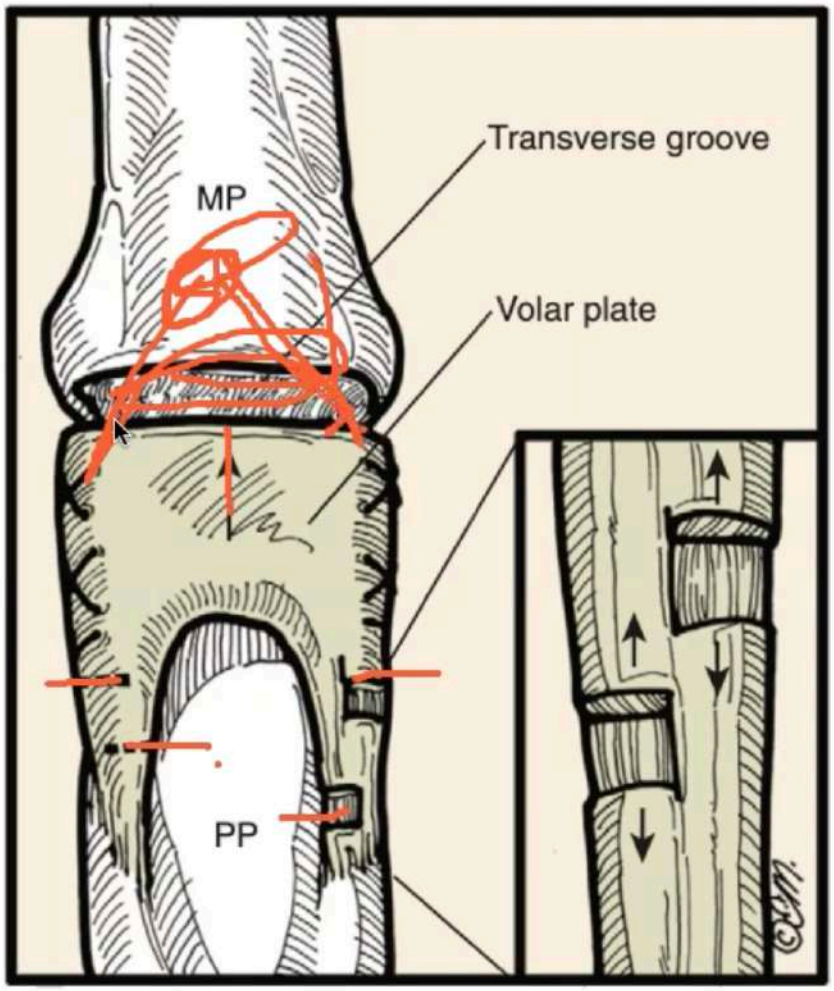


Figure 9.6 Step-cuts can be made along checkrein ligaments to allow distal advancement of volar plate into the defect. *(Copyright Elizabeth Martin.)*

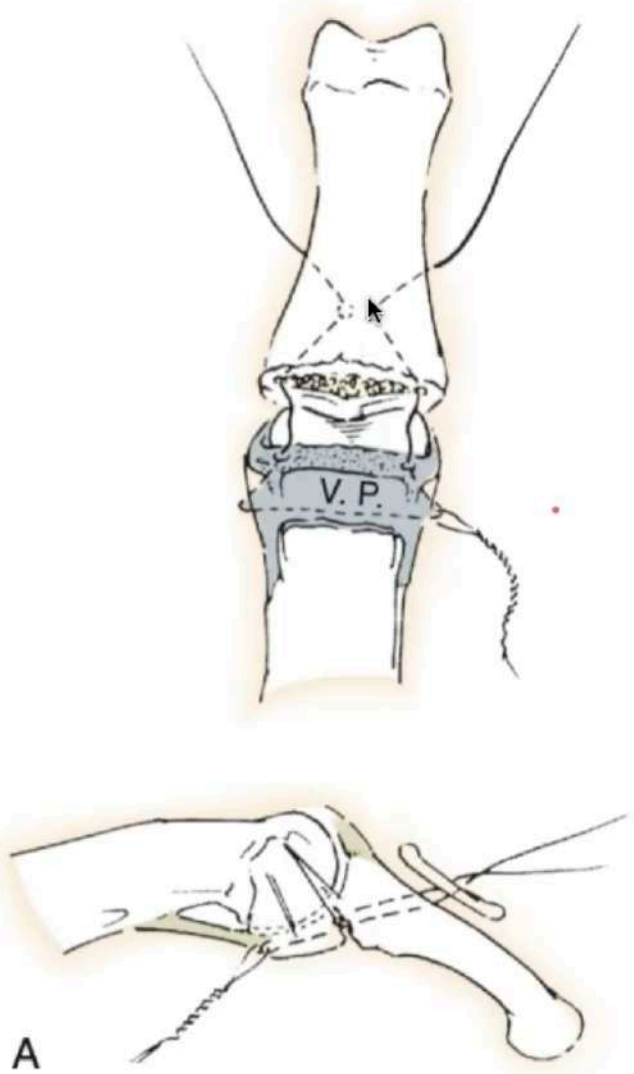


Figure 9.7 **A,** Volar plate advanced into defect of reduced joint and held with pull-out wires over a button. **B,** Radiograph showing a reduced joint with volar plate advancement.

Suzuki

- Distance between proximal and distal hooks is 2.5 cm which allow for adequate and not excessive distraction .

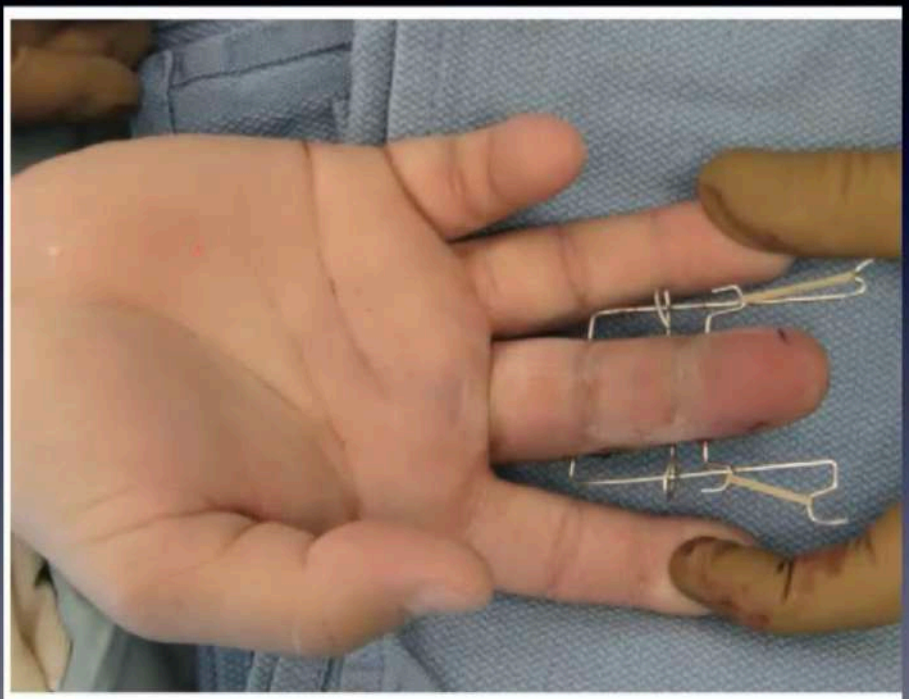


Figure 9.13 A third wire is added in middle axial line through middle phalanx. Downward pressure can be applied to joint with this wire to prevent dorsal subluxation without excessive traction.

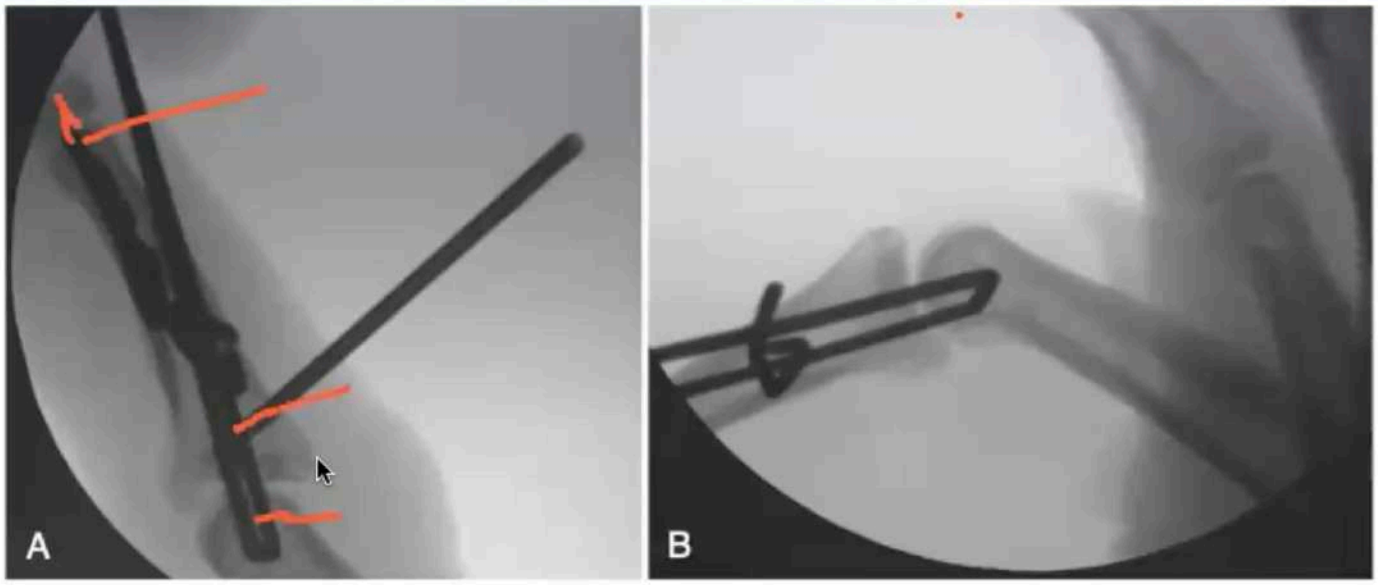
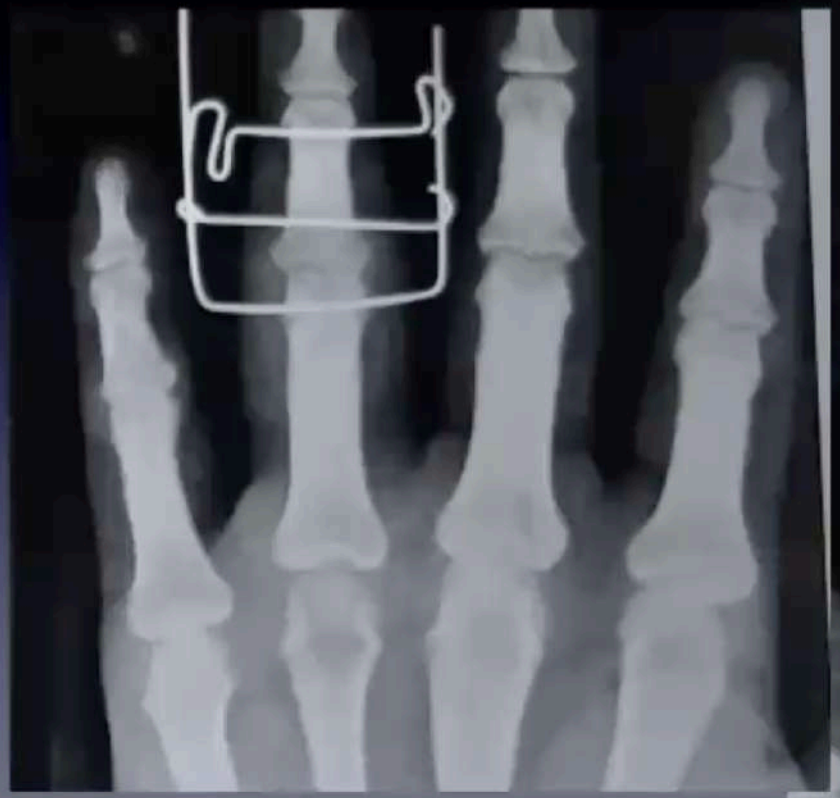
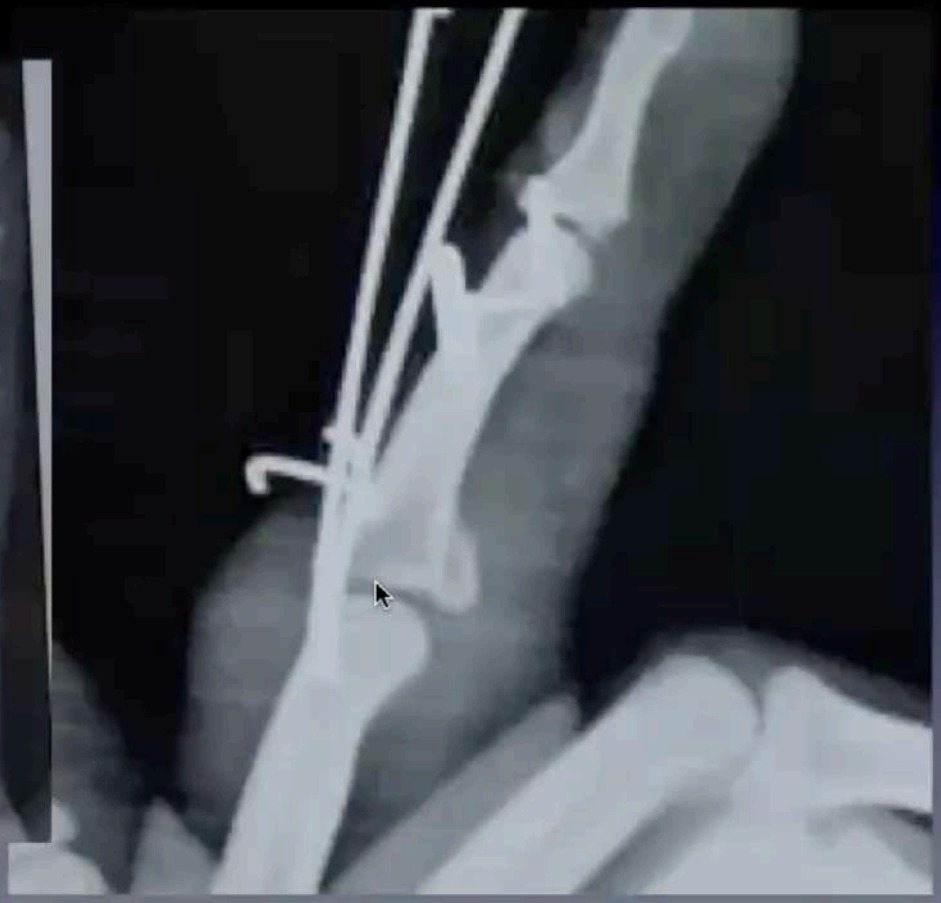


Figure 9.15 **A,** Percutaneous introduction of 18-gauge needle to tamp down impacted fragments. **B,** Reduction after tension is on dynamic fixator and joint is reduced percutaneously.

Intra op

Suzuki Frame





3 week follow up

5 months follow up

5 months follow up

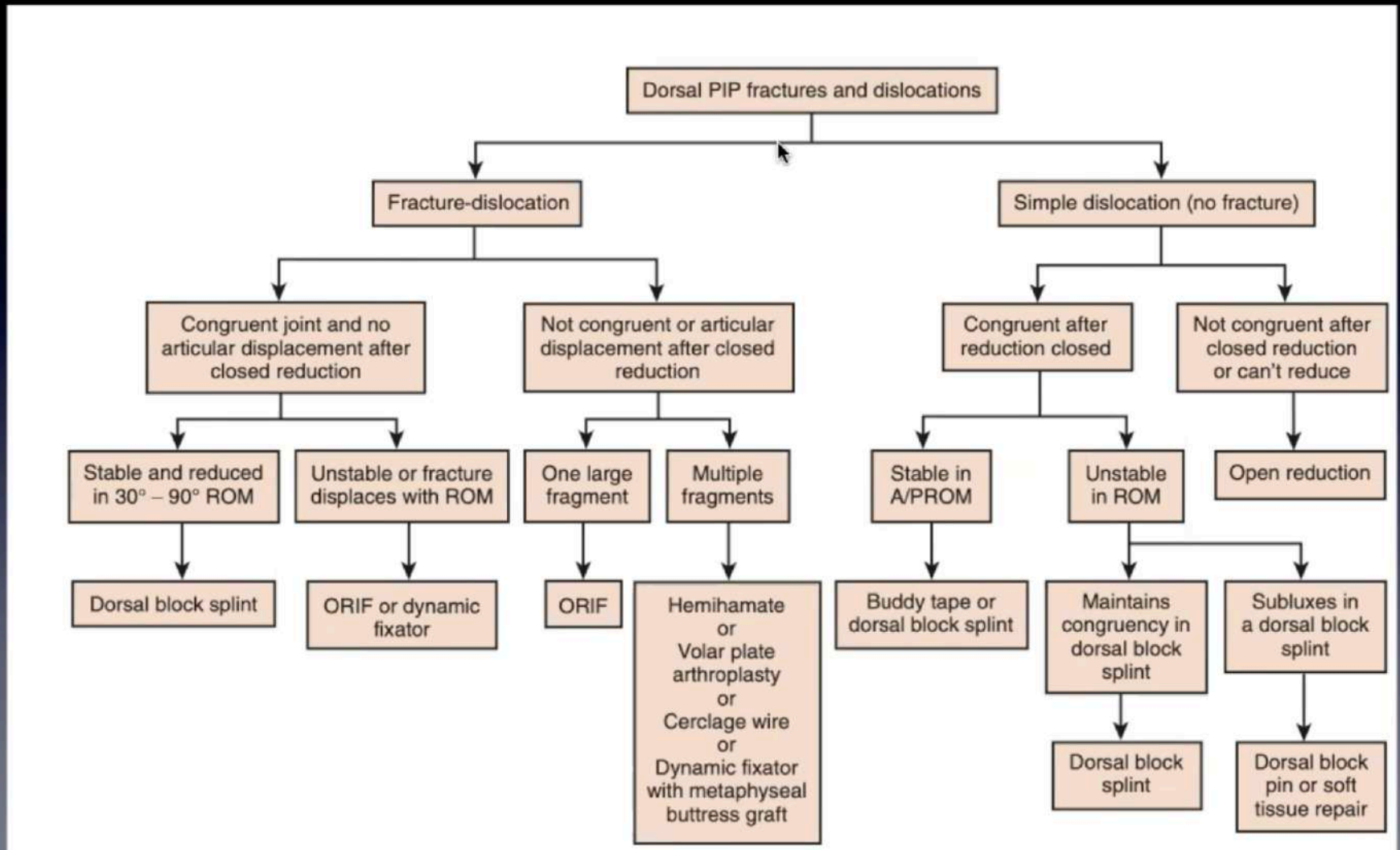
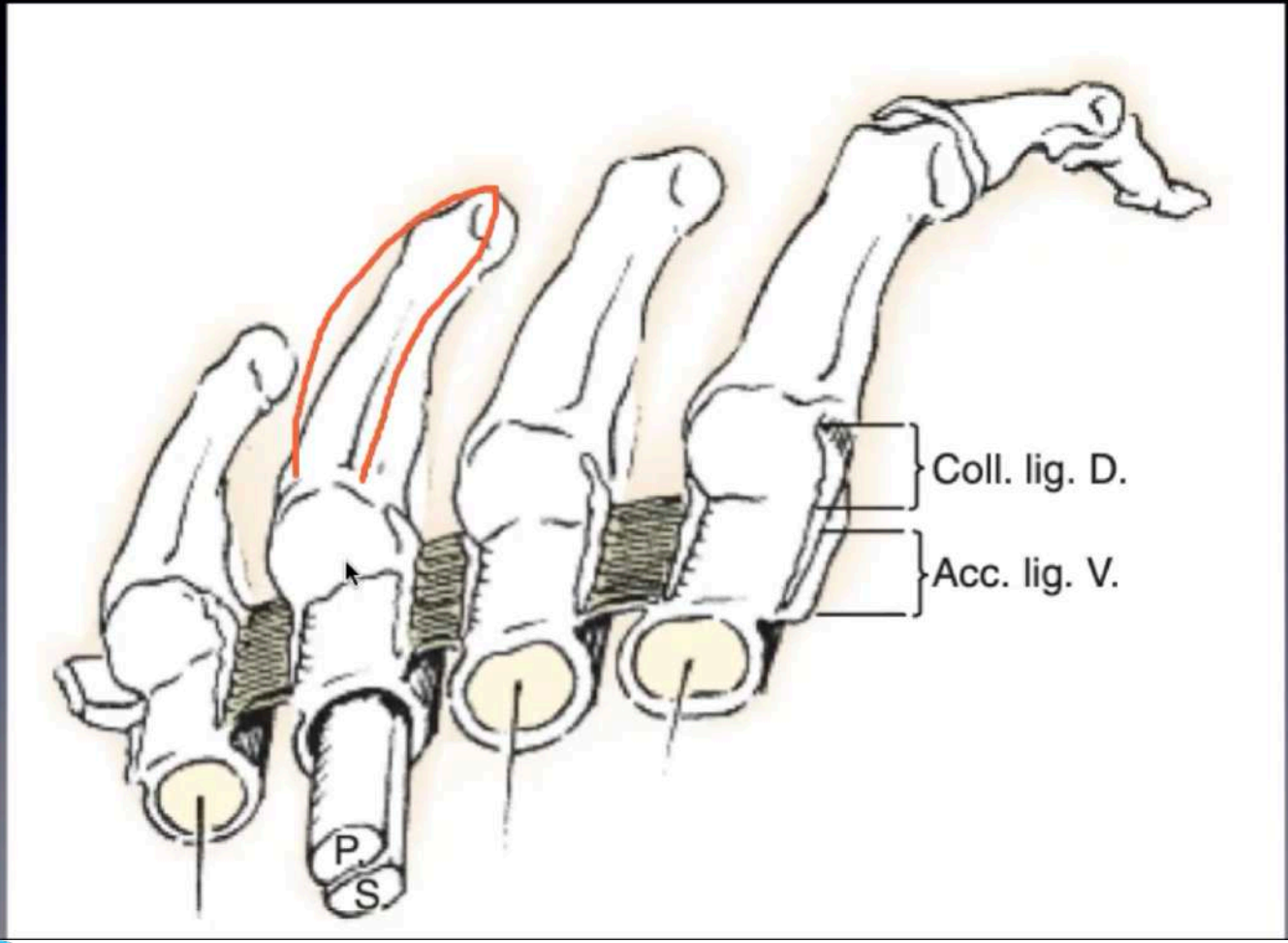


Figure 9.3 Treatment algorithm for PIP joint fractures and dislocations. A/PROM, active/passive range of motion; ROM, range of motion.

Finger MCP joint dorsal dislocation

Finger MCP JOINT - LIGAMENT BOX -

Collateral ligament, Intervolar ligament



Finger MCP Joint - Collateral Ligament

- MORE **TAUT IN FLEXION**
- [**NON SPHERICAL METCARPAL HEAD**]- LONGER DORSAL VOLAR AXIS THAN PROXIMAL- DISTAL AXIS
- MORE BROADER AND STABLE ARTICULAR CONTACT BEYOND 70 DEGREE OF FLEXION

Finger MCP Joint - Collateral Ligament

- MORE **TAUT IN FLEXION**
- [**NON SPHERICAL METCARPAL HEAD**]- LONGER DORSAL VOLAR AXIS THAN PROXIMAL- DISTAL AXIS
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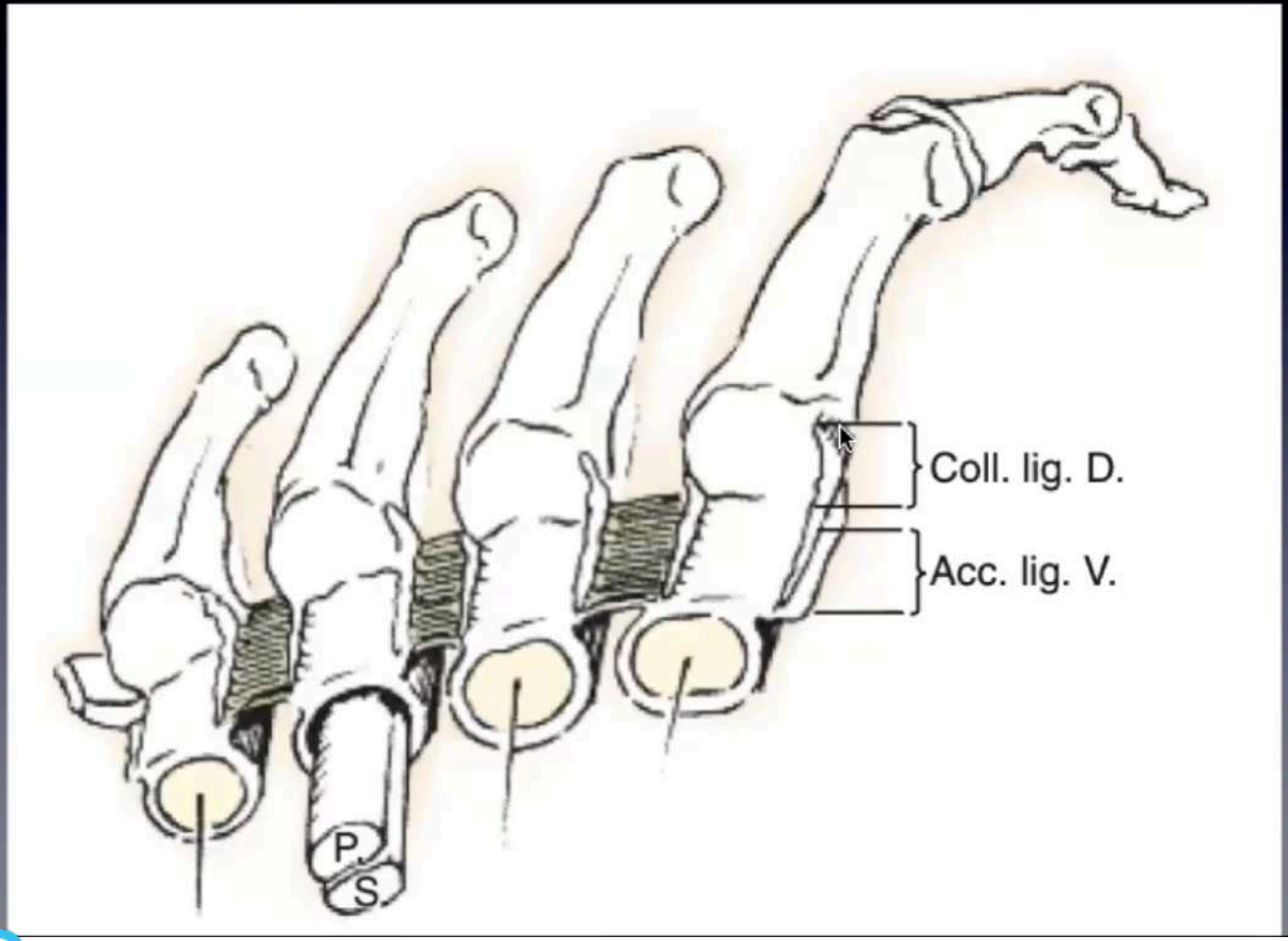
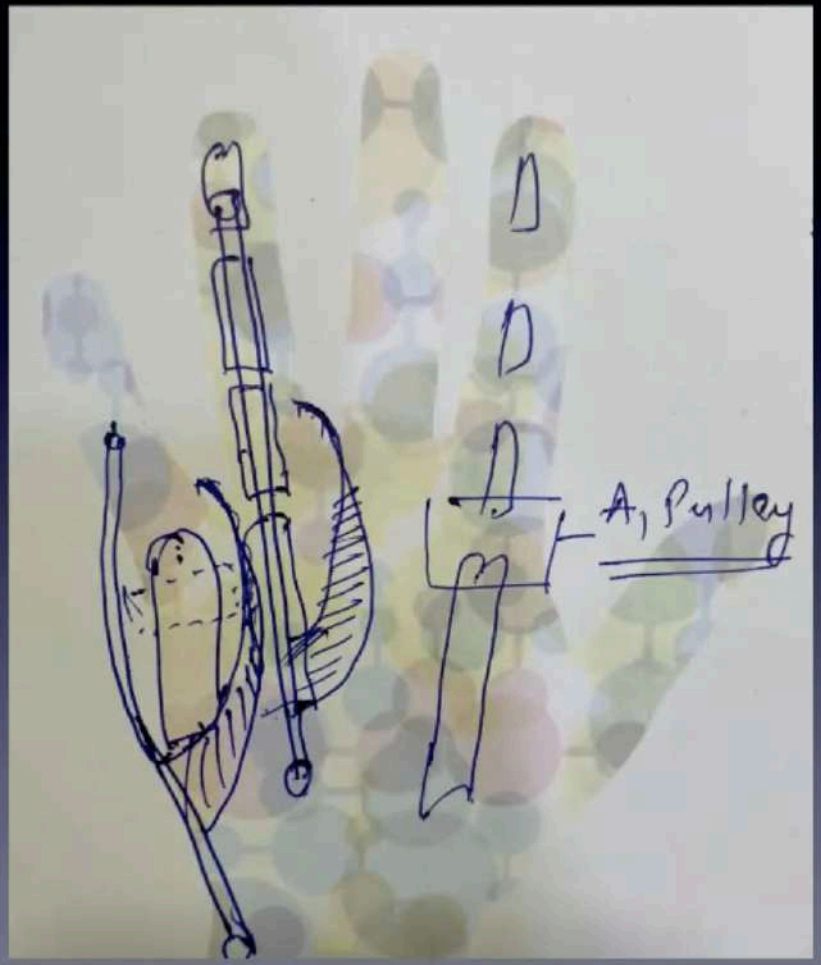
Finger MCP JOINT - LIGAMENT BOX -
Collateral ligament, Intervolar ligament



Finger MCP Joint - Volar plate

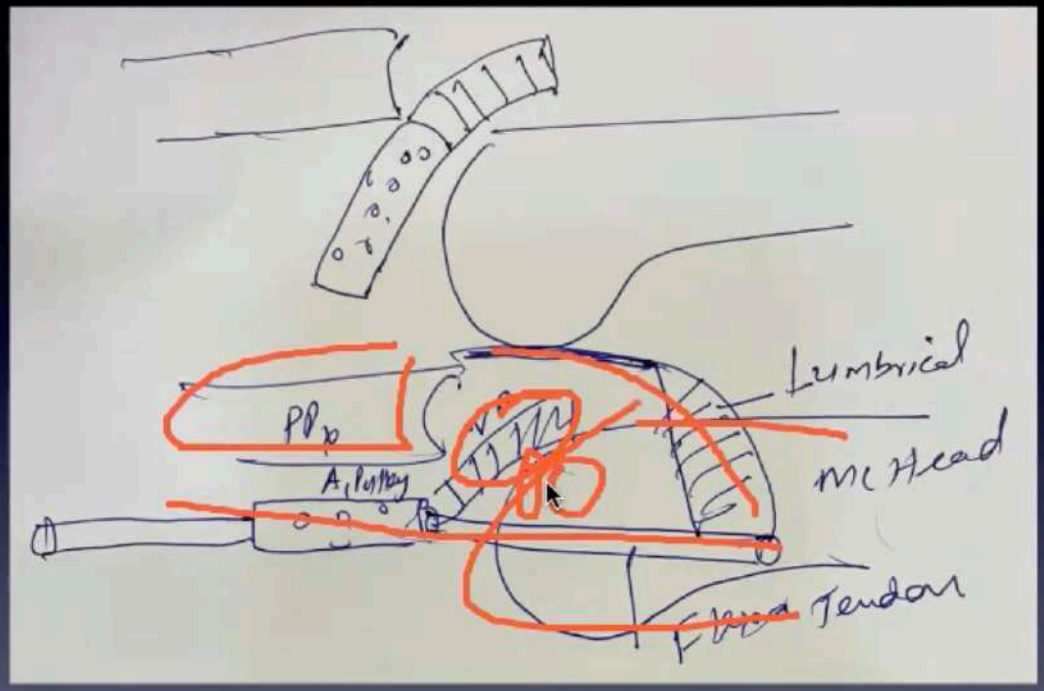
- CHECK REIN LIGAMENTS - Not strong like PIP JOINTS
- VOLAR PLATE - securely Attach to PPX and not MPX

Finger MCP Dislocation - ANATOMIC BASIS



- VOLAR PLATE
- A1 PULLEY
- FLEXOR TEDON on ulnar side
- LUMBRICALS on radial side
- **IN SMALL FINGER** - ABDUCTOR DIGITI AND FLEXOR DIGITI QUINTI

Sequence of finger MCP dorsal dislocation



- VOLAR PLATE - DRAWN DISTALLY AN DORSALLY BY DISLOCATING PPX OVER MC HEAD

- PERIARTICULAR TENDON NOOSE FORMS AROUND MC HEAD THAT ONLY TIGHTEN FURTHER WITH CLOSED REDUCTION

Finger - MCP dorsal Subluxation

- Simple - reducible - **PPX** IS HYPER EXTENDED [MARKED DEFORMITY]
- Complex - irreducible dislocation

Finger
MCP Complex Dorsal Dislocation

Figure 9.31 Radiographs of dorsal irreducible (complex) dislocation. **A,** Oblique view shows dorsal dislocation and widened join

Finger - MCP complex dorsal dislocation

- PPX - MILD EXTENDED **and not** hyper extended
- DIP JOINT MILD FLEXED
- DIGITS DEVIATED TO CENTRE DIGIT
- MCP JOINT - WIDENED JOINT SPACE
- SESAMOID BONE WITHIN JOINT - INDICATE ENTRAPPED VOLAR PLATE

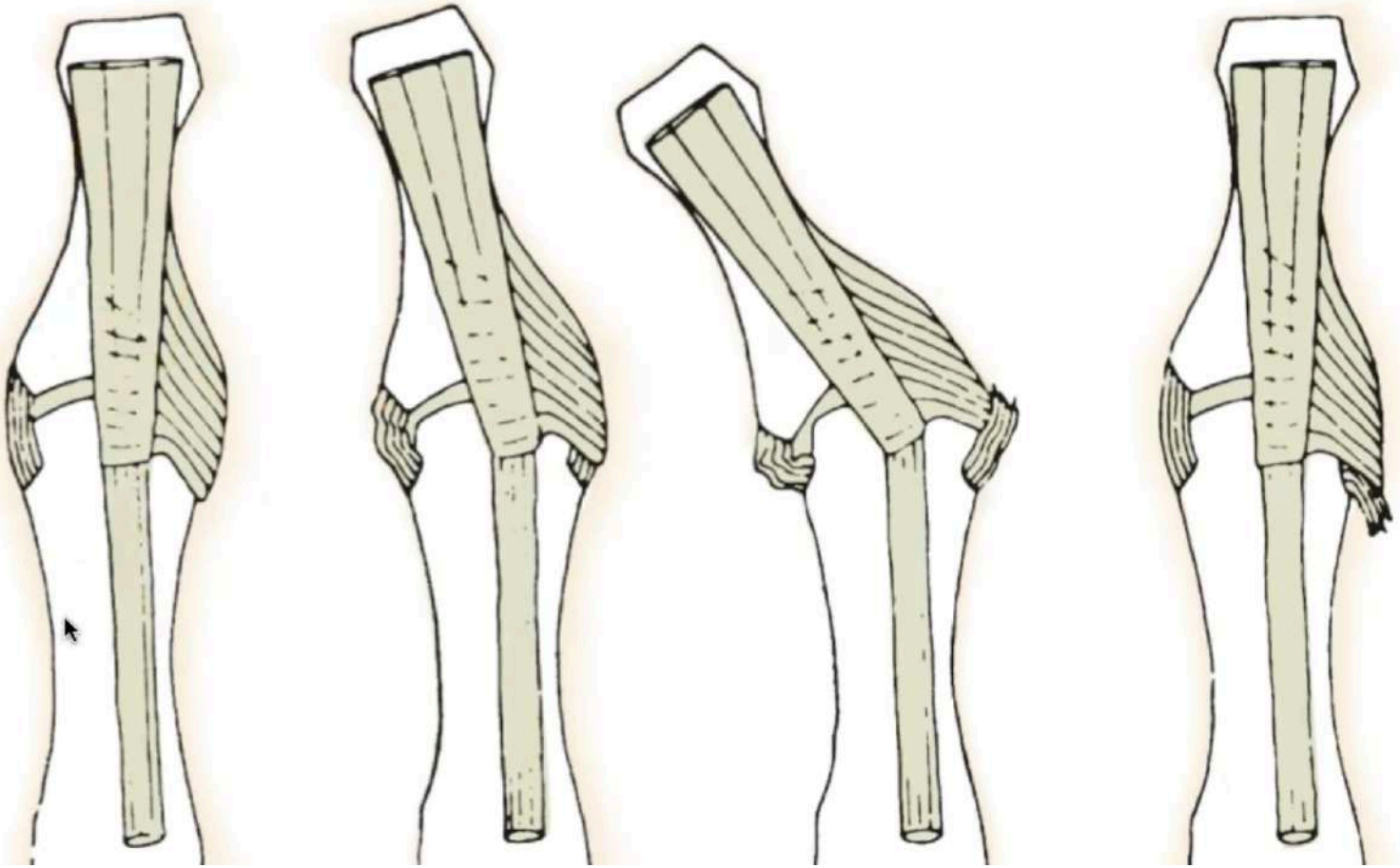
Close Reduction Technique for MCP subluxation

- VOLAR PLATE IS DRAPED OVER MC HEAD AND NOT ENTRAPPED WITHIN JOINT
- MAIN DETERRENT TO REDUCTION IS THE TENSION IN TENDON NOOSE AROUND THE METACARPAL NECK THAT CAN BE RELEASE BY
- FLEXING WRIST for close reduction or A1 PULLEY RELEASE for open reduction .
-

Skiers thumb

Acute UCL injury thumb

Distal tears are common



Stener lesion

- Adductor aponeurosis interposed between
- Distally avulsed ligament and
- Insertion into base of proximal phalanx
- **Stener lesion does not occur in partial UCL rupture .**

Treatment

- Splint
- Suture anchor

Figure 9.33 Athletes with minor injuries to UCL can be returned to play after 2 to 4 weeks of immobilization with protective "playing splint."

Gamekeeper thumb

Chronic UCL ligament injury thumb

6 weeks is criteria for chronic injury of UCL thumb

- PL tendon graft reconstruction -static - Best
- Adductor advancement - Dynamic

- Skin incision
- Edematous UCL lying proximally

Figure 9.34 Incision for repair or reconstruction of ruptured UCL of MP joint of thumb. Exposure is excellent, and healing leaves almost imperceptible scar.

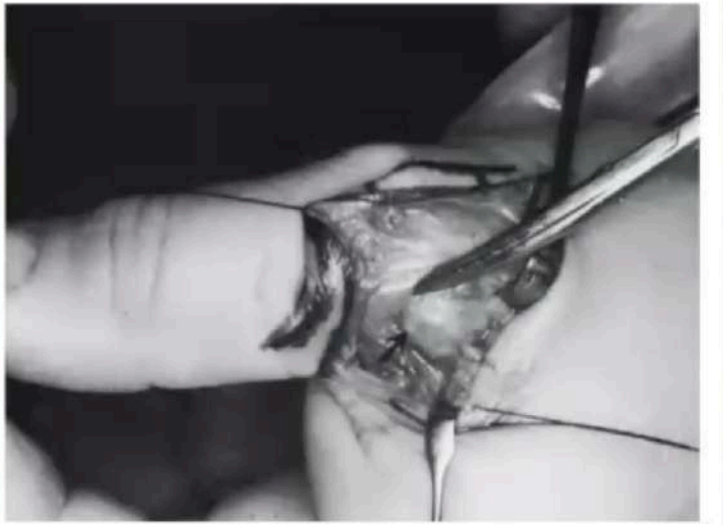


Figure 9.35 Displaced edematous end of UCL lying proximal to edge of adductor aponeurosis.

PL tendon graft reconstruction

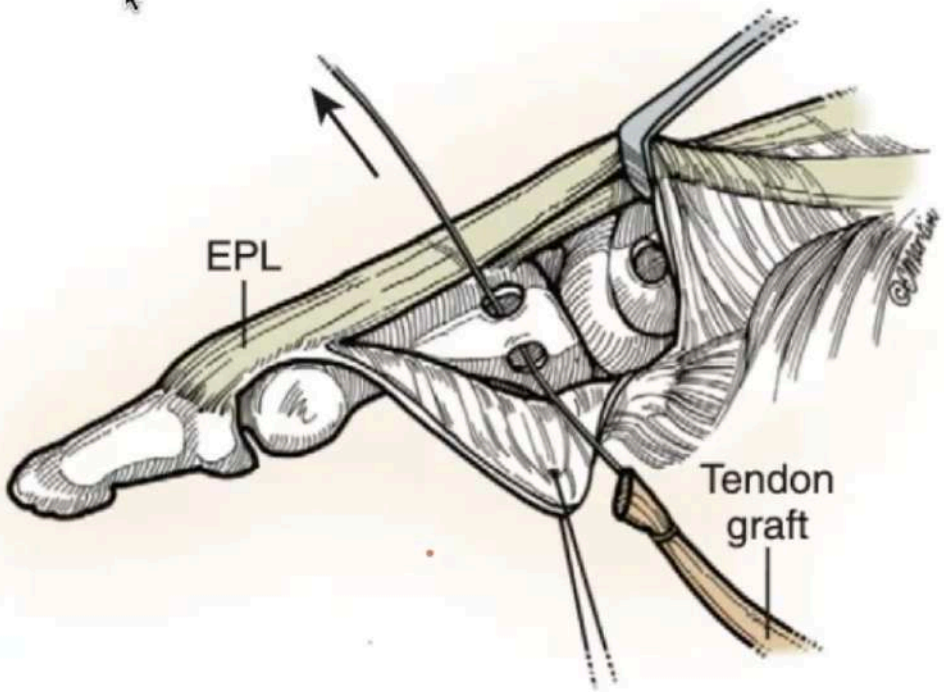


Figure 9.37 Authors' preferred method for reconstruction of UCL with free tendon graft. Gouge holes are made at 1-o'clock and 5-o'clock positions on ulnar side of base of proximal phalanx. Second gouge hole is made slightly obliquely across metacarpal neck. *(Copyright Elizabeth Martin.)*

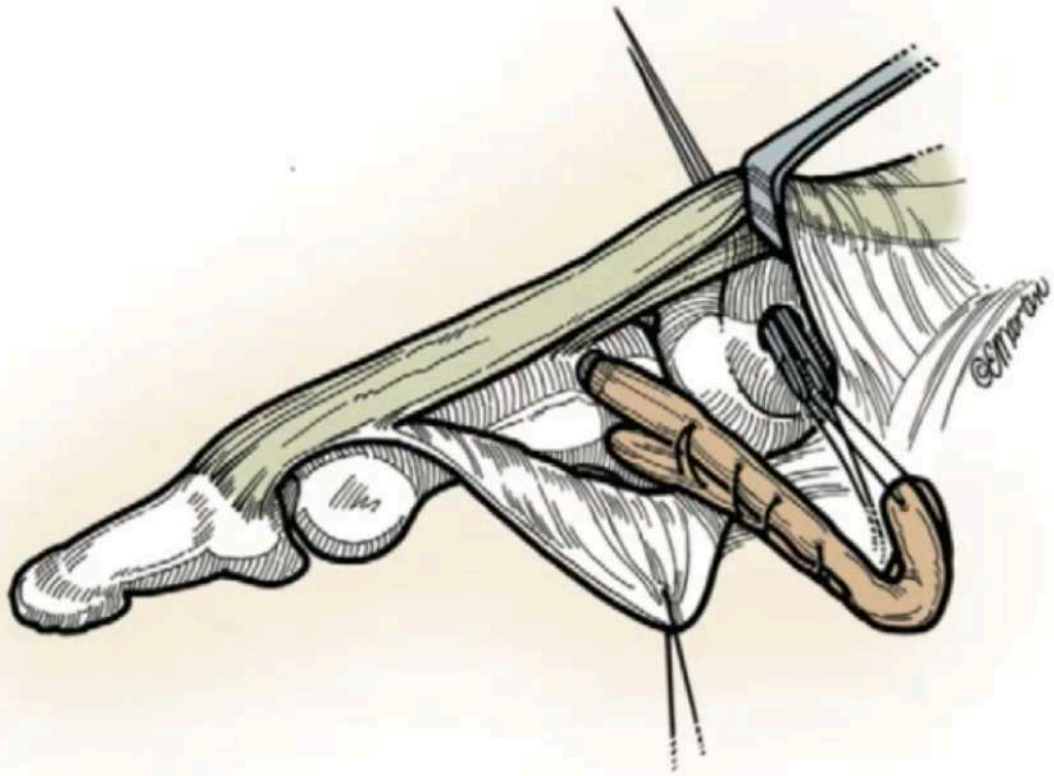


Figure 9.38 Ends of free graft are whipstitched, and suture end is put on straight needles passed through radial cortex. *(Copyright Elizabeth Martin.)*

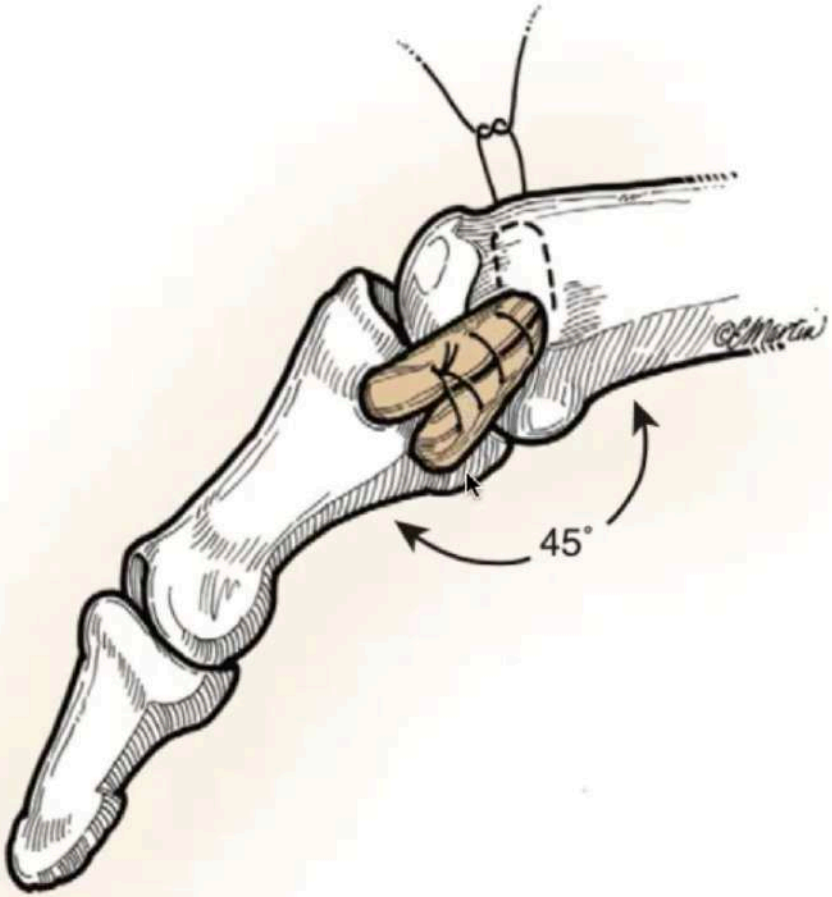


Figure 9.39 Graft is tensioned into docking hole in metacarpal head, and suture is tied down over radial cortex through small counterincision. *(Copyright Elizabeth Martin.)*

Thumb CMC dislocation

Cmc dislocation Thumb

- Most common is Dorsal dislocation
- Acute - percutaneous pinning

Figure 9.41 Radiograph of dorsal dislocation of thumb MP joint. Sesamoid proximity to proximal phalanx indicates that plate remains attached distally. Metacarpal head lies herniated between muscles that insert into these sesamoids.

THUMB CMC joint
Four major ligaments

- **Volar oblique ligaments** is primary restraint for dorsal dislocation

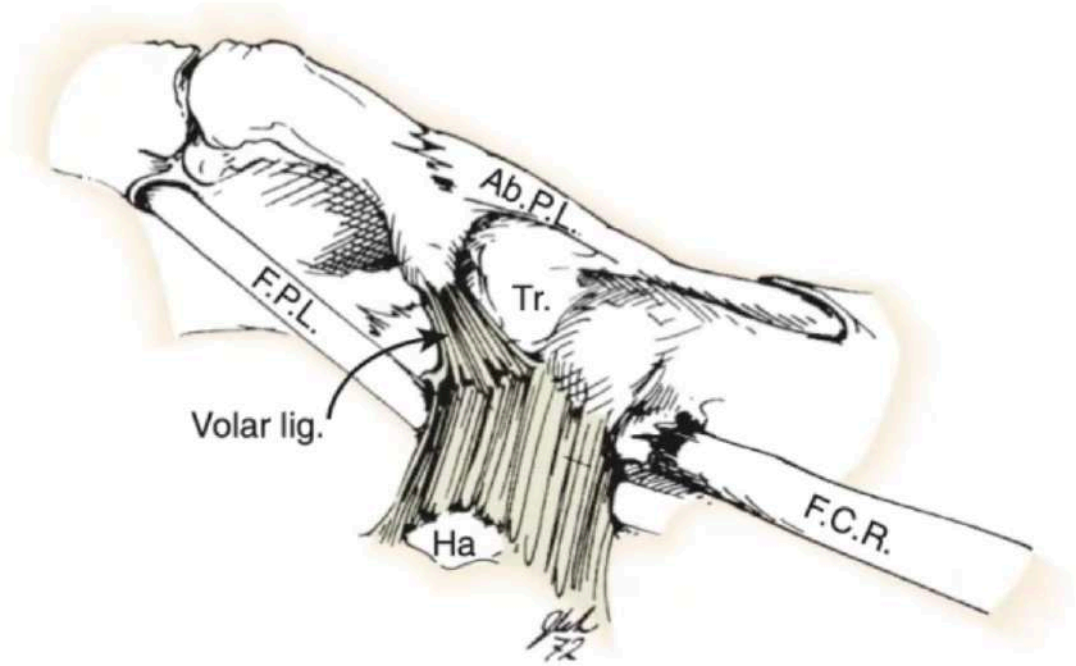
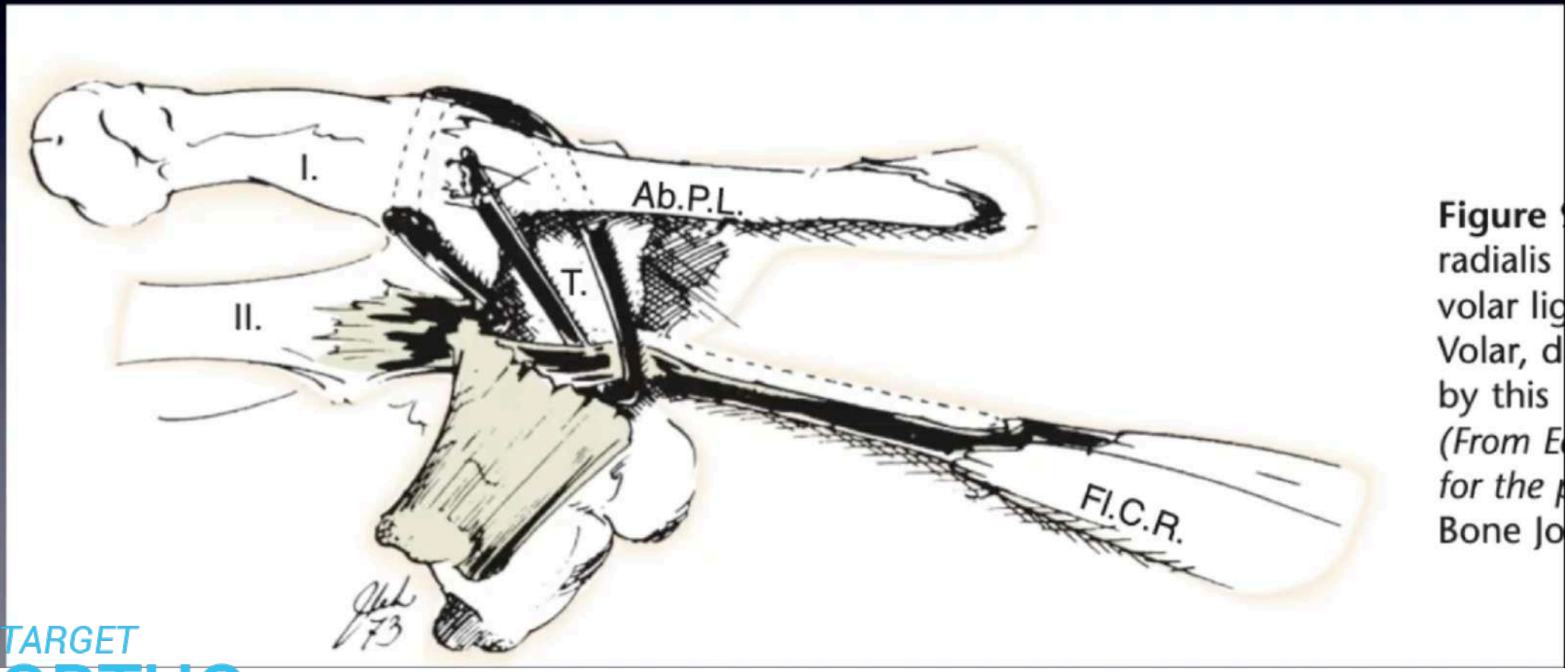


Figure 9.42 Essential anatomy of thumb CMC joint. Key structure is volar ligament, a short reflection of transverse carpal ligament that maintains thumb metacarpal in biconcave contour of trapezium. Ab.P.L., abductor pollicis longus; F.C.R., flexor carpi radialis; F.P.L., flexor pollicis longus; Ha, hamate; Tr., trapezium. *(From Eaton RG, Littler JW: Joint injuries and their sequelae,* Clin Plast Surg *3:85-98, 1976.)*

Treatment for chronic CMC thumb dislocation

Split FCR tendon used to reconstruct volar oblique ligament



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Thumb fracture

- Thumb is more forgiving in residual deformity than fingers
- Angulatory deformity < 15 -m 20 degree is acceptable
- Angulation <20- 30 degree in lateral plane is acceptable

Bennett's fracture is a fracture subluxation

- Articular fracture of base of thumb metacarpal
- Consist of
- Single volar ulnar fracture fragment
- Anterior oblique ligament holds the fragment to the trapezium and the remaining metacarpal base subluxate radially proximally and dorsally

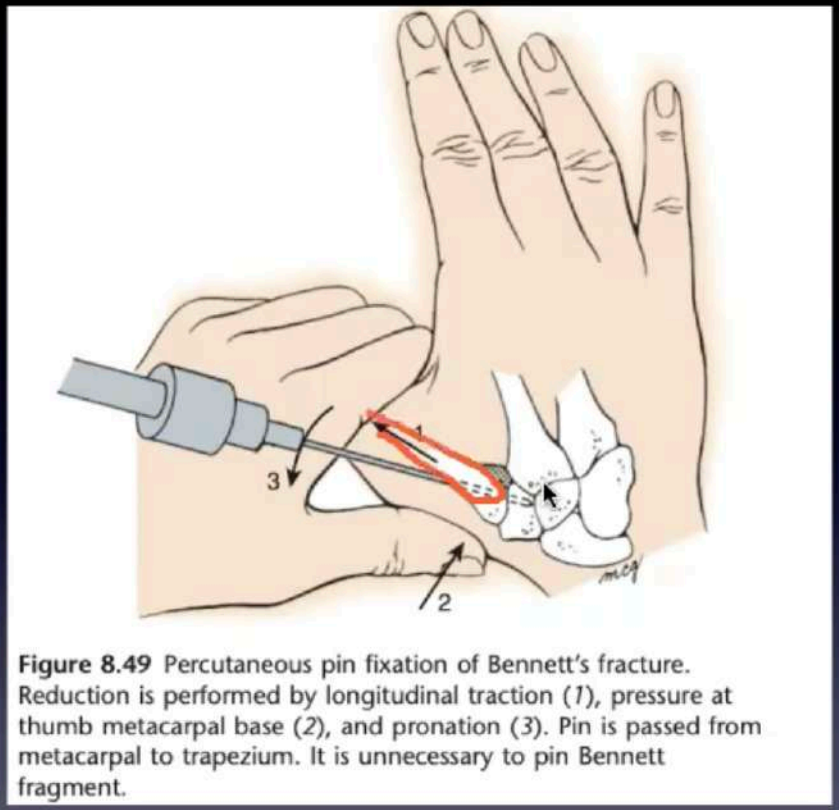


Figure 8.49 Percutaneous pin fixation of Bennett's fracture. Reduction is performed by longitudinal traction (*1*), pressure at thumb metacarpal base (*2*), and pronation (*3*). Pin is passed from metacarpal to trapezium. It is unnecessary to pin Bennett fragment.

Numerous techniques for closed reduction and percutaneous fixation have been recommended. Closed reduction and fluoroscopically guided percutaneous pinning from the thumb metacarpal into the trapezium without anatomic restoration of the metacarpal articular surface has become increasingly popular. Another technique is Kirschner pin fixation between the first and second metacarpals (intermetacarpal pinning) as advocated by van Niekerk and Ouwens.[136]

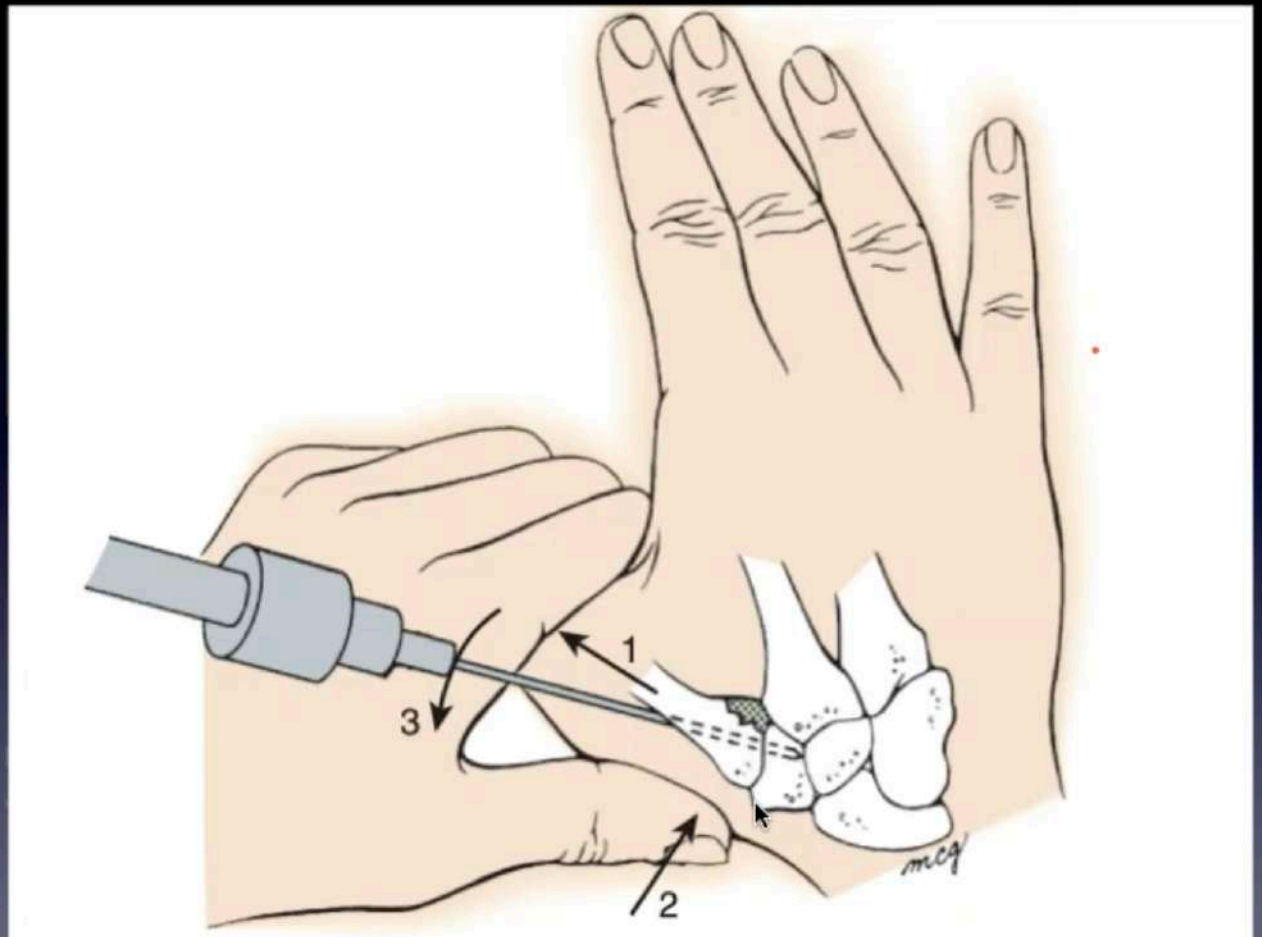
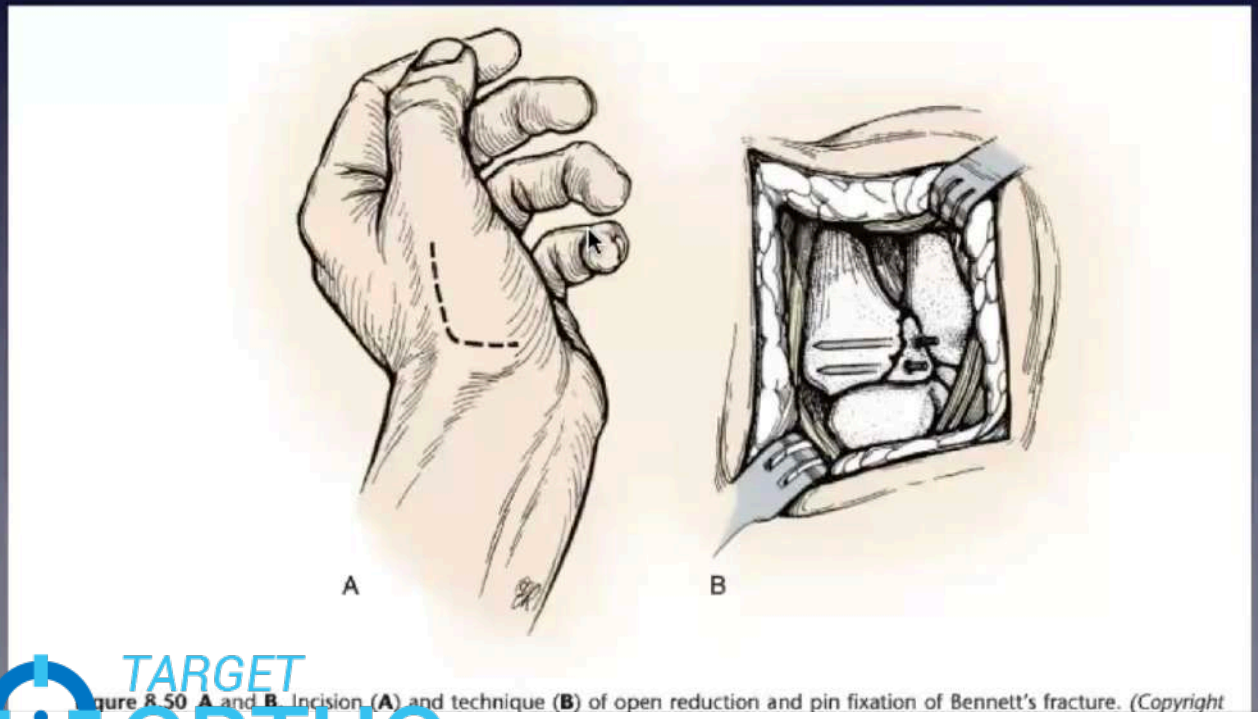


Figure 8.49 Percutaneous pin fixation of Bennett's fracture. Reduction is performed by longitudinal traction (*1*), pressure at thumb metacarpal base (*2*), and pronation (*3*). Pin is passed from metacarpal to trapezium. It is unnecessary to pin Bennett fragment.

image intensifier. If the metacarpal is reduced to the Bennett fragment, and there is less than 2 mm of articular step-off, we accept the reduction and immobilize in a thumb spica cast.



gure 8.50 **A** and **B** Incision (**A**) and technique (**B**) of open reduction and pin fixation of Bennett's fracture. *(Copyright*

Figure 8.51
lag screws.

Rolando fracture

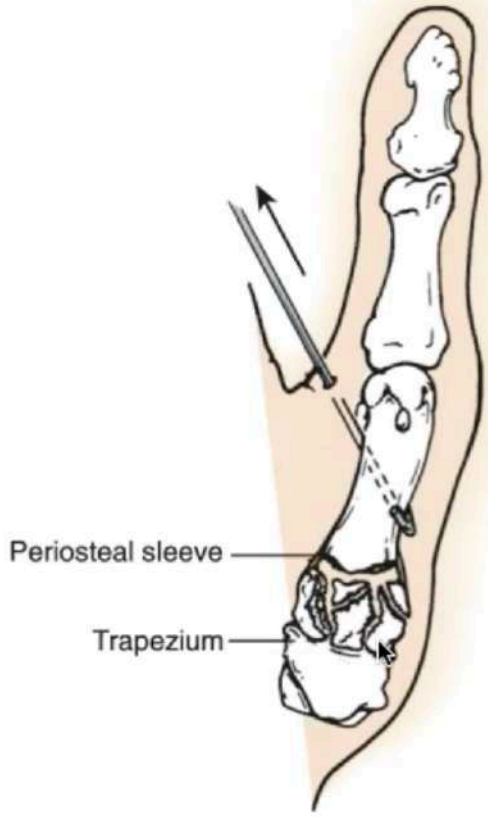


Figure 8.53 Oblique skeletal traction for comminuted fracture of thumb metacarpal base. Through small incision, 0.062-inch Kirschner pin is drilled obliquely through proximal metacarpal shaft and exits distally through thumb web. Pin is crimped

the comminution and extent of articular disruption. If a classic three-part Rolando fracture exists, we prefer ORIF with either multiple Kirschner pins or a plate. One should be

frustrating and unproductive. Buchler's technique of using quadrilateral external fixation, articular reduction with Kirschner pins, and cancellous bone grafting is a reasonable

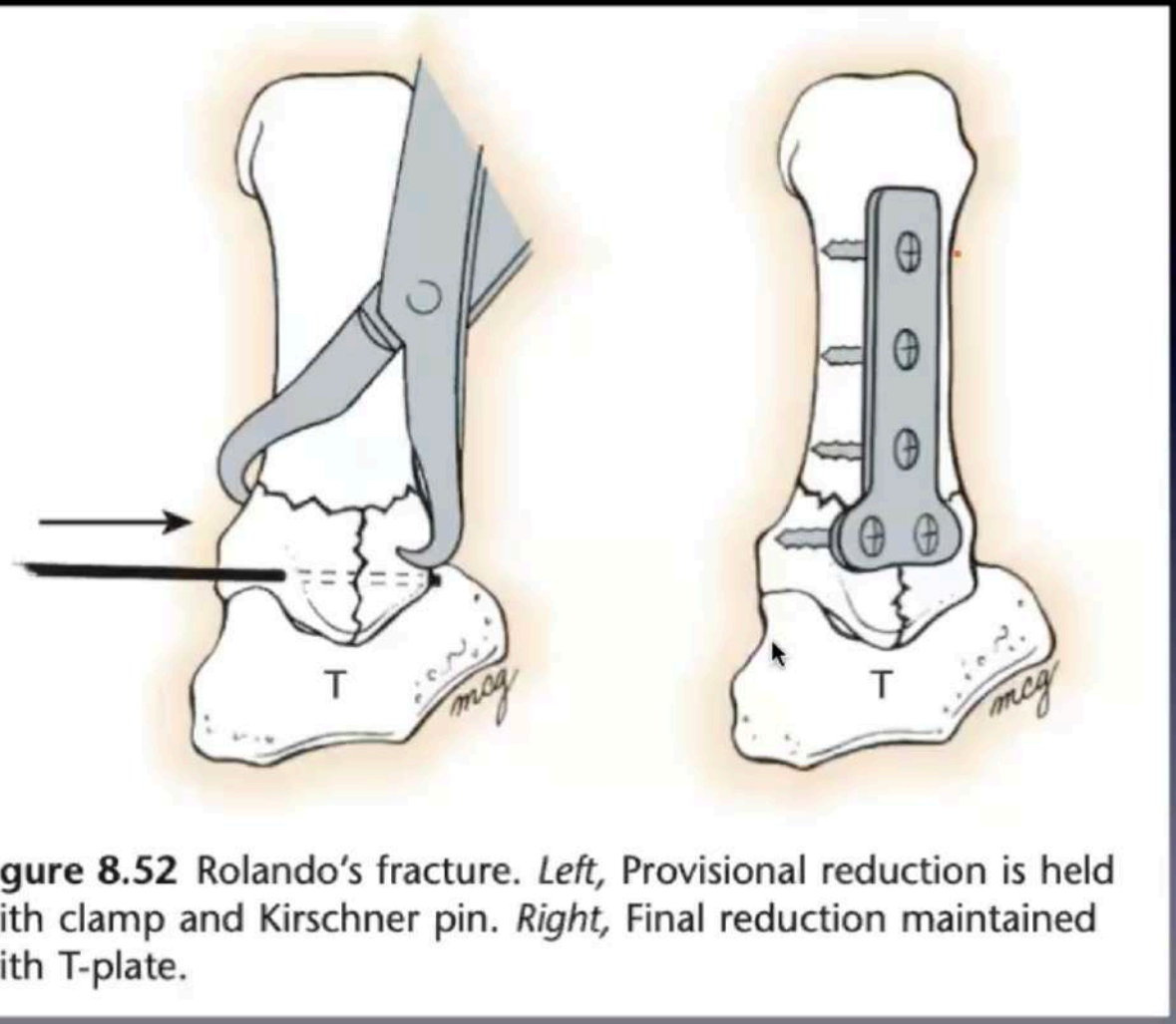


Figure 8.52 Rolando's fracture. *Left,* Provisional reduction is held with clamp and Kirschner pin. *Right,* Final reduction maintained with T-plate.

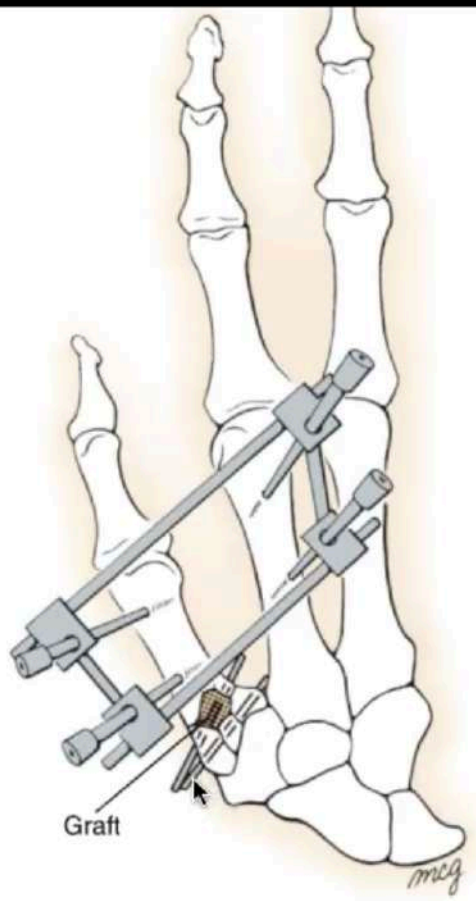


Figure 8.54 Quadrilateral frame for comminuted fracture of base of thumb. Two pins each are inserted into thumb and index finger metacarpals and interconnected with rods and swivel clamps. Thumb metacarpal articular surface is reduced and held with Kirschner pins, and metaphysis is grafted with cancellous bone.

SEYMOUR FRACTURE

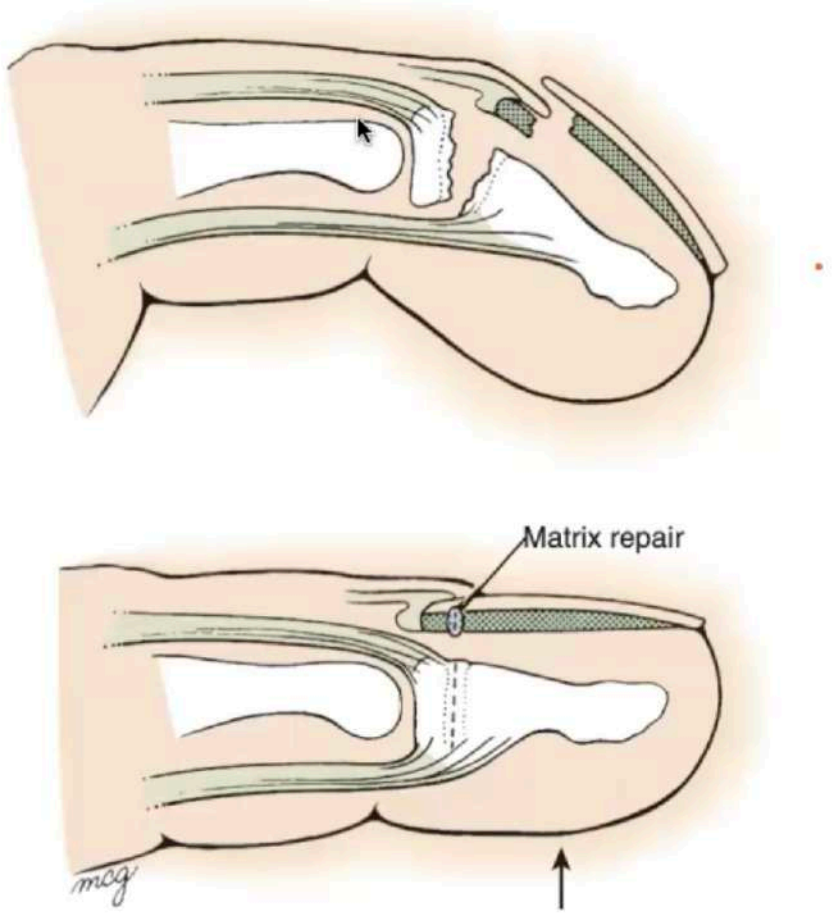


Figure 8.21 Open epiphyseal fracture of distal phalanx in a child. *Top,* Note matrix disruption (*stippled*); nail plate has been avulsed and is dorsal to proximal nail fold. *Bottom,* Reduction requires matrix repair and replacement of nail plate beneath proximal nail fold.