Extensor Tendon Injuries

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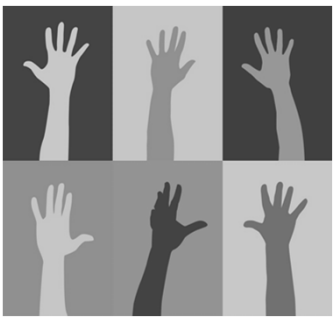
Objectives

1. Essential Anatomy
2. Standard Protocols
3. Immediate Controlled Active Motion



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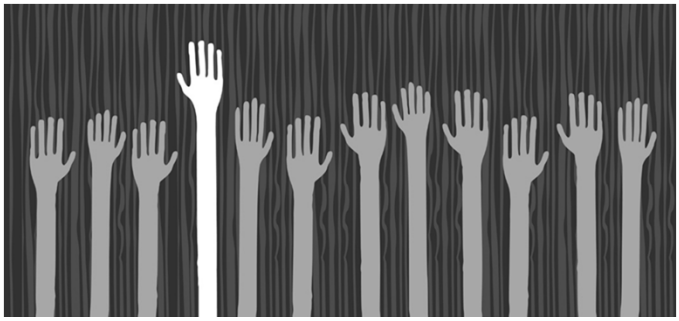
Essential Anatomy



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Zones

- Zone I: DIP
- Zone II: Middle phalanx (P2)
- Zone III: PIP
- Zone IV: Proximal phalanx (P1)
- Zone V: MP
- Zone VI: Metacarpals
- Zone VII: Extensor retinaculum

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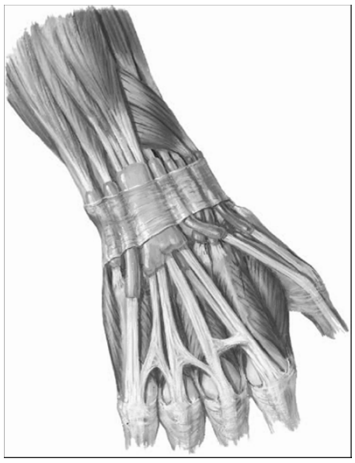
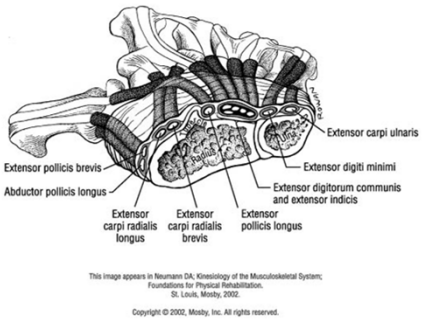
Extensor Compartments





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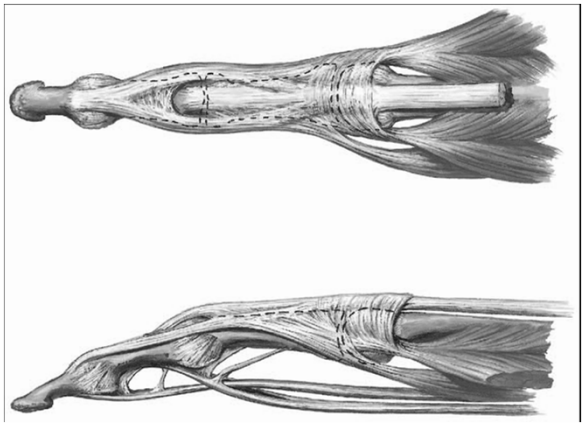
Extensor Mechanism

- Extrinsic extensor tendon insertions
- Intrinsic insertions
- Sagittal bands/dorsal hood
- Central slip/band
- Lateral bands
- Terminal tendon



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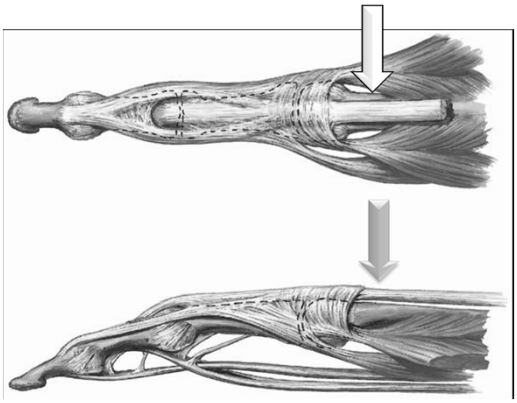
Extrinsic Extensor Tendon Insertions

- Extensor digitorum communis (EDC)
- Extensor indicis proprius (EIP)
- Extensor digiti minimi (EDM)

- *Insert into dorsal hood at MP joint*
- *Produce MP extension*



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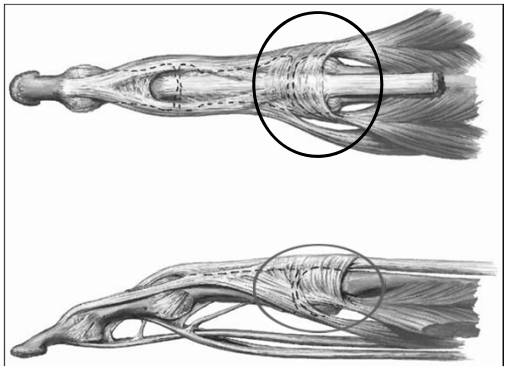
Intrinsic Insertions

- Lumbricals
- Dorsal interossei
- Palmar interossei

- *Volar to the MP joint axis; produce MP flexion*
- *Transmit forces dorsal to the PIP and DIP; produce PIP/DIP extension*
- *PAD: palmar adduct MP*
- *DAB: dorsal abduct MP*



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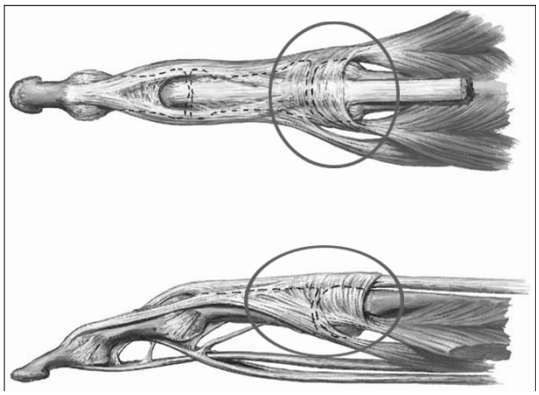
Extensor Mechanism

- Sagittal bands/dorsal hood
- *Serve as "mission control"*
- *Transmit forces from extrinsics and/or intrinsics through the extensor mechanism*



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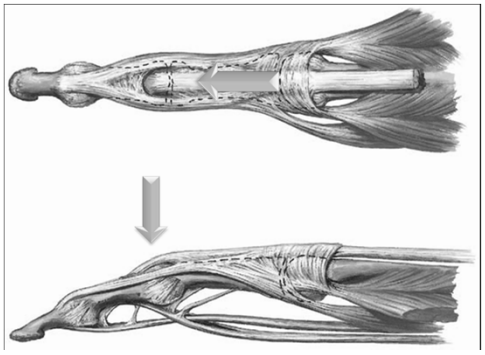
Extensor Mechanism

- Central slip/band
- *Produces PIP extension*
- *NOT the insertion of the extrinsic extensors*



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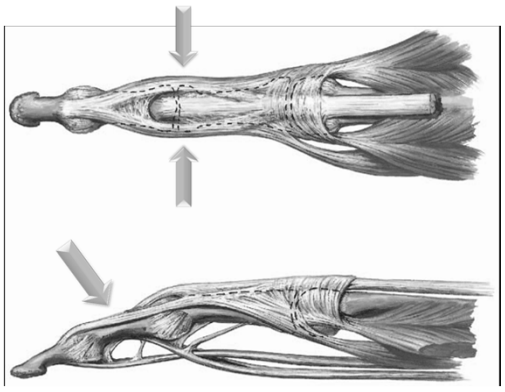
Extensor Mechanism

- Lateral bands
- *Maintain balance and stability of the PIP joint*



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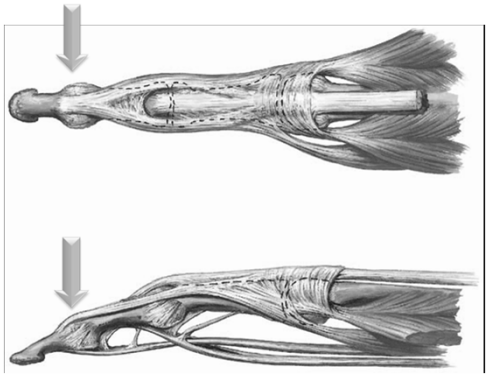
Extensor Mechanism

- Terminal tendon
- *Produces DIP extension*



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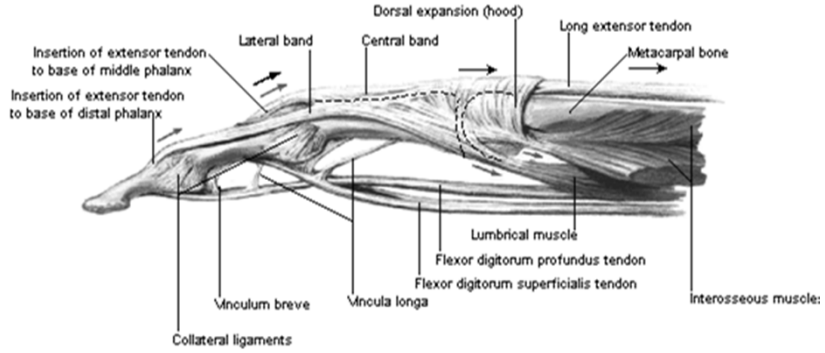

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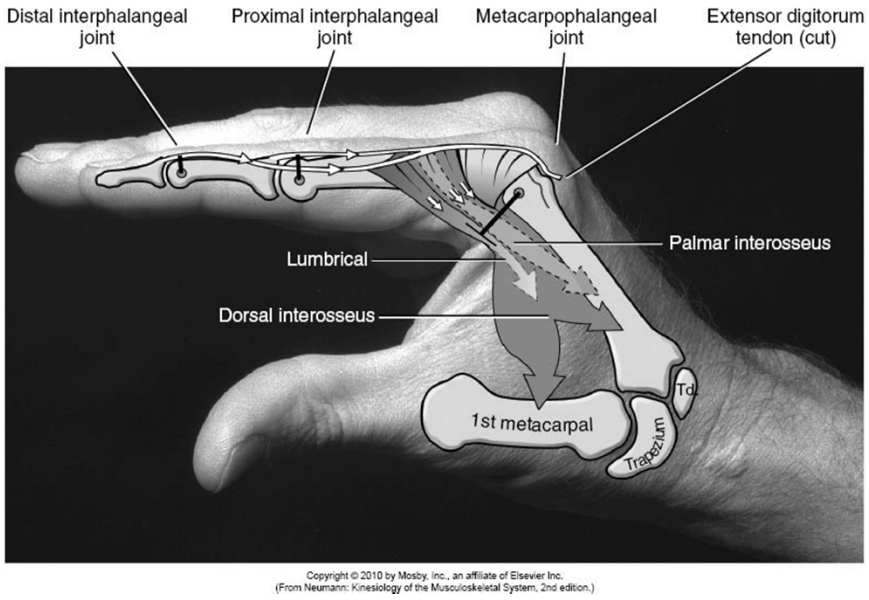

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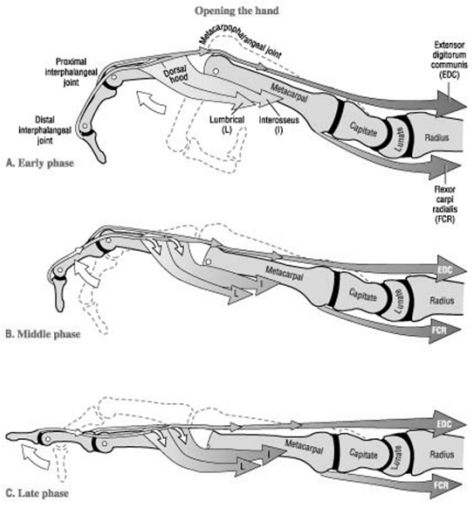

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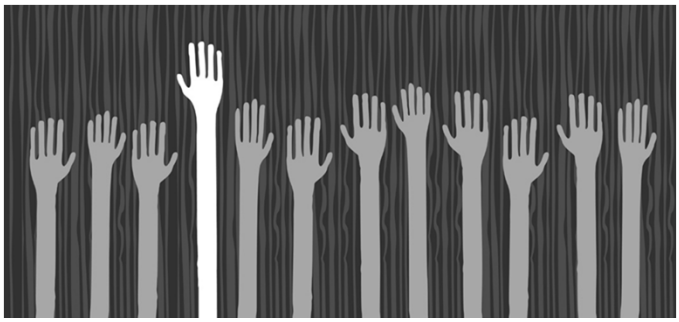
Standard Protocols



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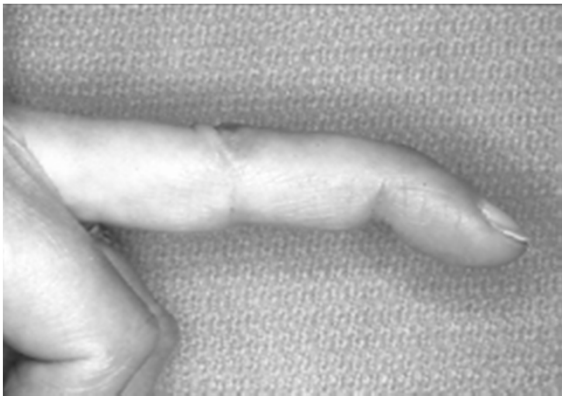
Zone I/II: Mallet Finger



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Zone I/II: Mallet Finger

- Type I
  - Rupture of tendinous insertion
  - Full time immobilization of DIP in full extension for 6-8 weeks
- Type II
  - Tendon laceration
  - Tendon repair with temporary immobilization of DIP in full extension

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Zone I/II: Mallet Finger

- Type III
  - Deep abrasion injury with loss of skin, tissue, and tendon substance
  - Soft tissue coverage and tendon repair/graft vs. DIP arthrodesis
- Type IV
  - Avulsion fracture (bony mallet)
  - Splinting vs. ORIF according to radiographic images
    - >30% of articular surface requires ORIF

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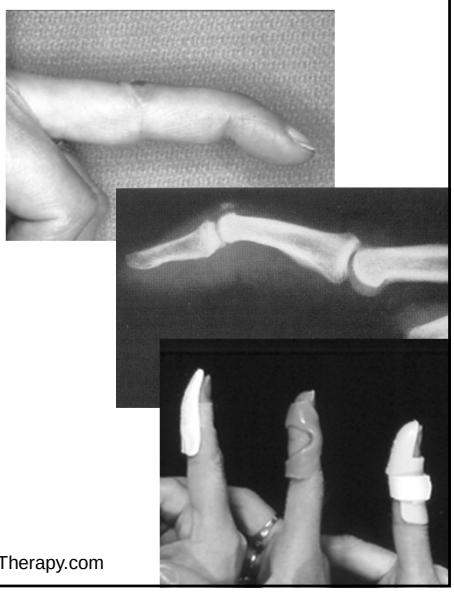
Zone I/II: Mallet Finger

- Immobilize for 6 weeks in full extension
- Dorsal or volar splints must support the DIP joint continuously in full extension
- PIP mobilization



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Rehabilitation

- Gradual splint weaning
  - Morning, afternoon, evening, night
- Composite flexion
  - Avoidance of isolated joint motion
- Lateral tracing of digit

If an extensor la… …ring the protocol resume … …crease or d… …es

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Zone III/IV: Boutonniere Deformity

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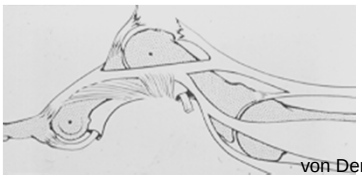
Zone III/IV: Boutonniere Deformity

- Lateral bands transmit force towards PIP flexion and DIP hyperextension
- PIP flexion contracture
  - Pseudoboutonniere
    - *the DIP joint remains passively flexible*
  - True boutonniere
    - *the DIP joint cannot be passively flexed*



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Zone III/IV: Boutonniere Deformity

- Stage I
  - Dynamic boutonniere that is passively mobile
- Stage II
  - Established deformity that cannot be corrected passively
  - Immobilization of PIP in full extension for 6-8 weeks
  - Active flexion of DIP to maintain length of oblique retinacular ligament and facilitate return of lateral bands

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Zone III/IV: Boutonniere Deformity

- Stage III
  - Established deformity with resultant structural changes of the PIP joint
  - Surgical release of PIP and correction of extensor mechanism as needed

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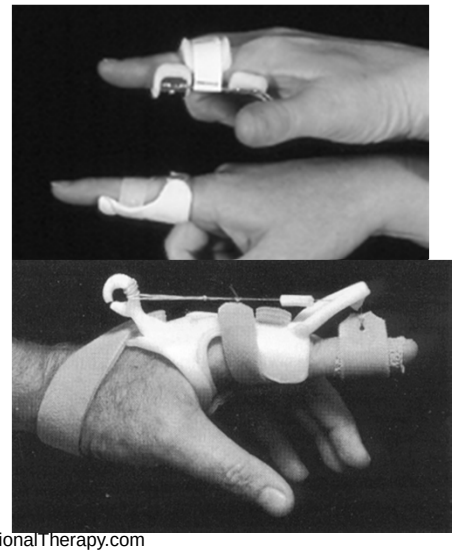
Rehabilitation

- Conservative
  - PIP joint immobilization at 0° extension 6-8 weeks
- Immediate passive extension
  - Outrigger splint supporting the PIP at 0° with rubber band traction
  - 30 degrees of flexion or more allowed at PIP joint
    - *Walsh et al., 1994*
    - *Thomes, 1995*



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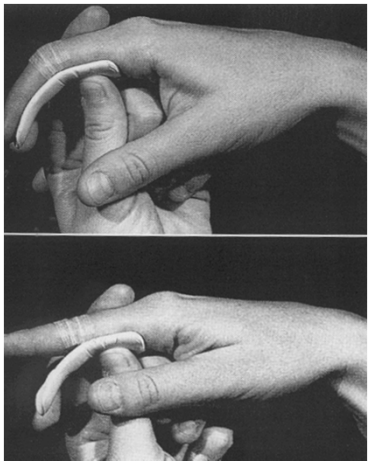
Rehabilitation

- Short arc motion (SAM)
  - *Evans, 2002*
- PIP and DIP immobilized at 0° extension between exercise
  - Template with 30° PIP and 20° DIP flexion
  - Finger flexion to the template with active extension to 0°
  - 10-20 reps every 1-2 hours
  - Template progressed weekly



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Chronic Boutonniere

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Rehabilitation

- Achieve full passive PIP extension using dynamic, static progressive, serial static splints or casts.

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Rehabilitation

- Aggressive DIP flexion with PIP supported in full extension
- Add passive PIP flexion
  - Two weeks or more after splinting is discontinued
  - *If flexion is not increasing (and extension remains good)*

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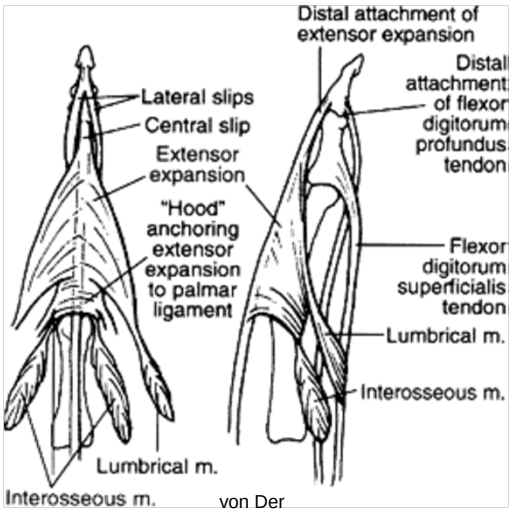
Zone V: MP Joint



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Zone V: MP Joint

- Dorsal hood/Sagittal bands
  - Arise from the volar plate and transverse metacarpal ligament
  - Prevent bowstringing of the EDC during extension, maintain EDC at midline during flexion
  - Provide lateral support to the MP joint
  - Function to extend the MP joint
- Lumbrical and interosseous tendons
  - Volar to the MP joint axis
  - Assist in MP flexion

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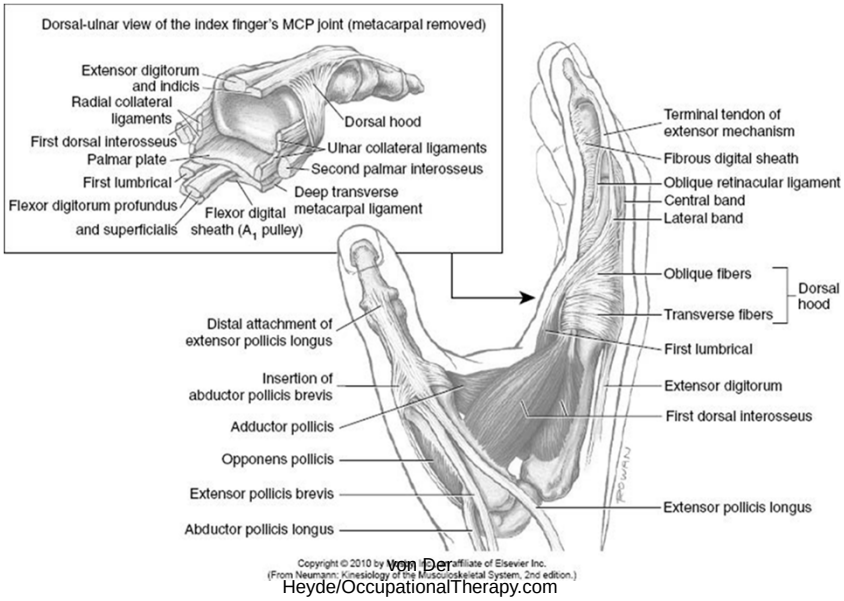
Zone V: MP Joint



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Zone V: Sagittal Band Tear

- Most often observed at the radial aspect of the long finger
- Clinical findings:
  - Edema over the affected MP joint
  - Localized tenderness
  - Pain with resisted digit extension
  - Incomplete MP joint extension
  - Deviation of the involved digit

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Zone V: Sagittal Band Tear

- Treatment:
  - Immobilization of MP in full extension for 6-8 weeks

    OR
  - Reconstruction/repair of sagittal band with centralization and stabilization of the extensor tendon

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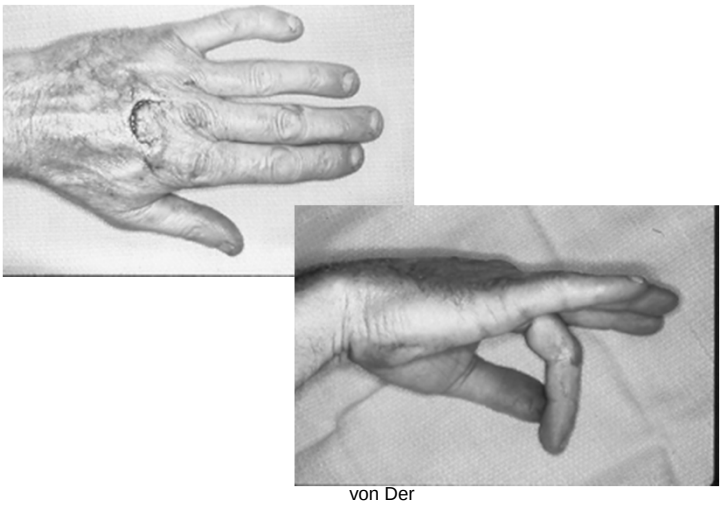
Zone VI-VIII



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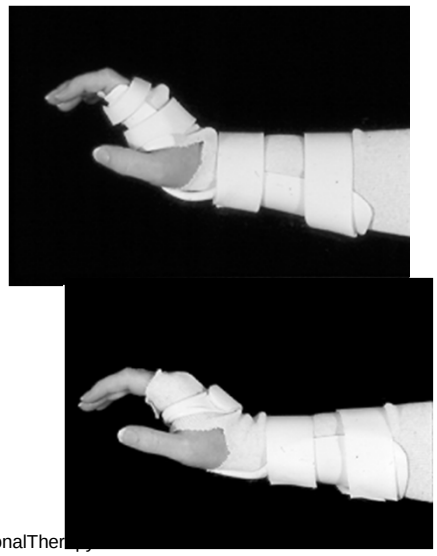
Zone V-VII Conservative Management

- Zone V
  - Wrist 40-45°extension
  - MPs 0-20° flexion
- Zone VI-VII
  - Wrist in 40° extension



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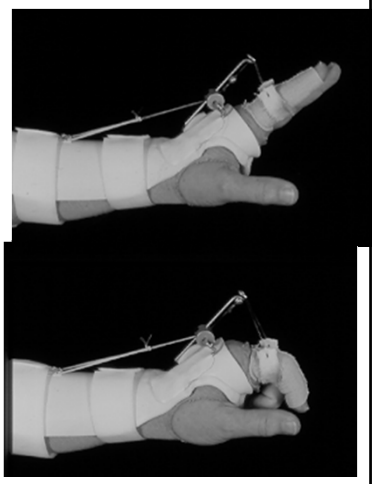
Zone V-VII: Immediate Passive/Active Extension

- Dynamic extension splint
  - Volar block/stop allowing 30° MP flexion
- *Evans & Thompson, 1993*
  1. Passive wrist extension, MPs relax to 40°
  1. Passive digit extension, wrist relaxes to
     - 0° to 20° flexion (Zones V-VI)
     - 10° extension (Zone VII)
     - 20° extension if wrist extensors are repaired



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Rehabilitation

- Initiate AROM carefully
  - MP flexion with IPs extended
  - "Hook fist": PIP/DIP flexion with MP extension
  - Progress to composite AROM after 4 weeks
  - Monitor extensor lags closely
  - Timely initiation of scar management

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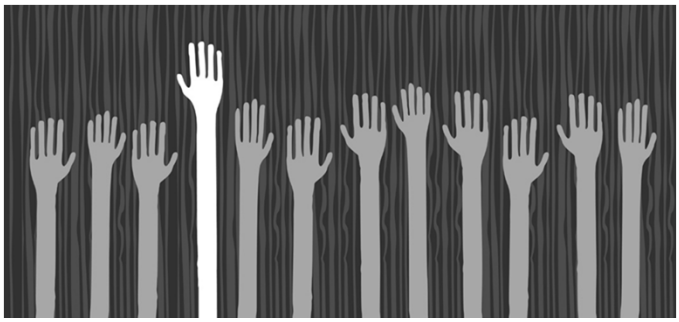
Immediate Controlled Active Motion



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"Immediate Controlled Active Motion Following Zone 4-7 Extensor Tendon Repair"

Journal of Hand Therapy
Howell, Merritt, & Robinson (2005)

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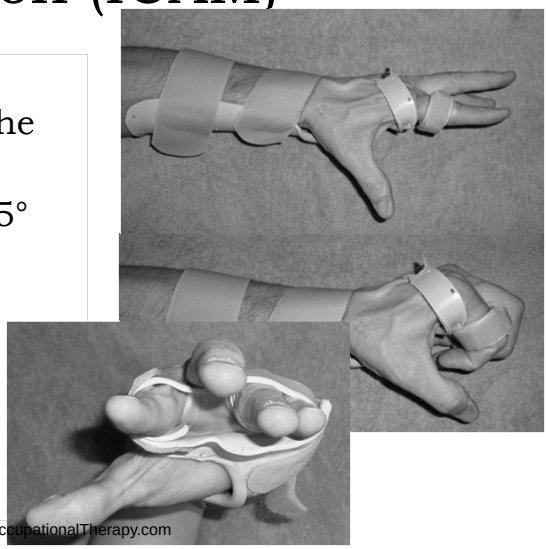
Immediate Controlled Active Motion (ICAM)

- Concept based on "relative motion" of the MP joint
- Wrist placed at 20-25° extension
- MPs in 15-20° more extension relative to other MP joints



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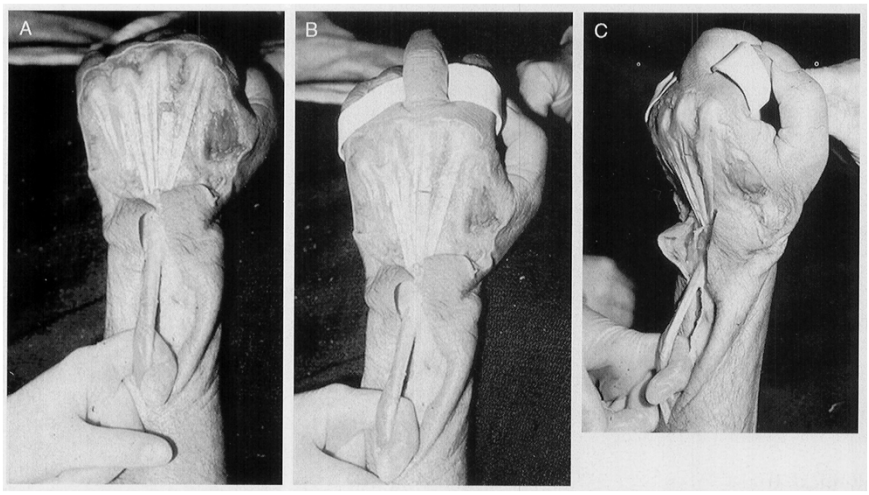

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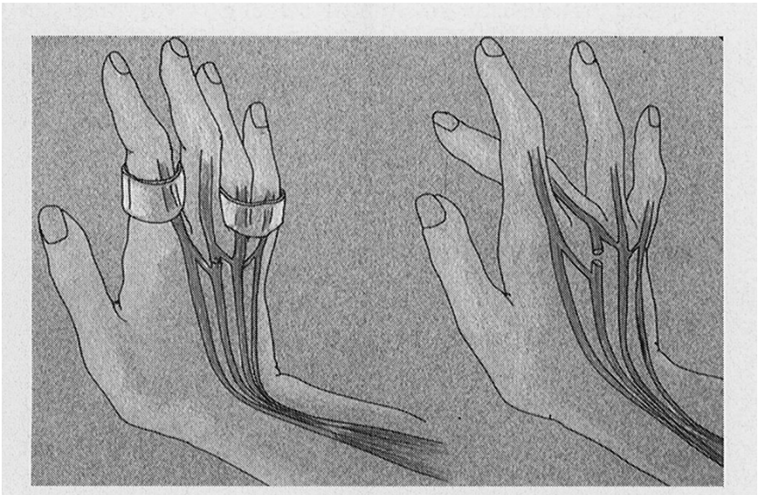

FIGURE 4. *ICAM yoke links the injured digit to the noninjured digits. The yoke may function to unload the repair and harness extension forces during active motion.*

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Protocol

- Inclusion criteria
  - Injury to at least one but not all extensor tendon(s) in zone 4-7
  - 2 visits in first 10 days
  - 1 visit per week thereafter
- Phase 1
  - 0-21 days post repair
  - Edema and scar management
  - Both splint components worn continuously
  - Goal: Full active motion within limits of splint

Protocol

- Phase 2
  - 22-35 days post repair
  - Yoke splint worn at all times
  - Wrist splint removed for active wrist motion
  - Goal: Composite wrist/digit flexion and extension without extensor lag
- Phase 3
  - 36-49 days post repair
  - Wrist splint discarded; yoke or buddy strap worn during activity
  - Yoke splint removed for active digital motion

TABLE 3. **Configuration of the ICAM Finger Yoke When a Single Finger is Involved.**

Index	*Long*	*Ring*	*Small*	*Yoke Configuration*
XX	O	O	X	
O	XX	O	O	
O	X	XX	O	
X	O	O	XX	

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Outcomes

- *Robinson et al., 1986*
  - ASHT Annual Meeting, New Orleans
  - 22 patients
  - *"full ROM within 5 weeks of surgery, joint stiffness was nonexistent and no patient required a therapy program after removal of the splint"*
- *Howell et al., 2005*
  - 140 patients
    - No extension lag: 114 patients
    - 5-10° lag: 21 patients
    - 11-44° lag: 5 patients
  - Average discharge 49 days
  - No complications or secondary surgeries

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Review of Objectives

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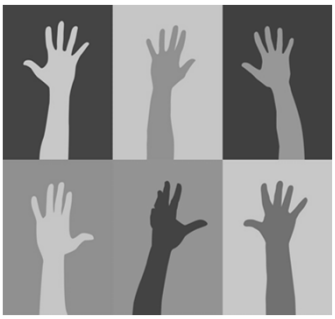

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Questions?

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