Extensor Tendon

Black short arrow—Extensor tendon
Long black arrow—Interosseus tendon
S—Sagittal band
C—Central slip
D—Distal slip insertion
Arrowhead—intermingling of the interosseus and extensor tendon
Extensor Tendon Anatomy Dorsum of Digit

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EXTENSOR TENDON INJURY: TREATMENT BASED ON ZONE OF INJURY

Zone I

**Mallet Injury**

- Rupture/interruption of the terminal tendon at the level of the DIP
- Clinically no active extension, however full passive
- May be an open or a closed injury
- May have associated fracture—bony mallet
- Hyperextension of the PIP may be seen due to unopposed lateral band tension at the PIP joint and joint laxity
Treatment Zone 1 and II Mallet deformity

Acute injury < 3 weeks

0-6 weeks
• Continual circumferential mallet splint to the DIP joint only, with hyperextension of the DIP 10-15°. Neutral if associated fracture
• A volar gutter finger splint may be used if wound care is required
• AROM exercises to the MCP and PIP joint of the finger 15 reps hourly
• Wound care as indicated
• Scar Massage
• Monitor for concurrent swan-neck deformity
• Monitor skin integrity

6 weeks
• Circumferential X-lite mallet discontinued if no active extension lag
• Volar mallet splint molded. Worn for night-time/sleeping
• AROM exercises to the DIP joint to increase flexion 15 reps hourly
• Continue circumferential mallet if extension lag persists. Splint x2 additional weeks. Then begin volar splint and AROM
• Active composite fisting exercises
Treatment Zone 1 and II Mallet deformity
Acute injury < 3 weeks

7-8 weeks
• Night-time/sleeping volar mallet splinting is continued.
• PROM to DIP if no extensor lag
• Active composite fisting exercises 15-20 reps hourly
• Hand and pinch strengthening exercises

9 weeks
• Mallet splinting is discontinued
• Progressive hand and pinch strengthening exercises
Zone I Chronic Mallet > 3 weeks

0-8 weeks
• X-lite mallet splint circumferential for continual wear. DIP in 15° hyper-extension
• AROM to MCP and PIP joints of the finger 15 reps hourly

8 weeks
• AROM to DIP joint. Gradually increase flexion
• Volar gutter mallet splint worn between exercises and for sleeping
• Re-splint in continual circumferential splint should mallet persist or re-develop

9 weeks
• PROM to DIP as long as DIP extensor lag is < 10°

Zone 1 Chronic mallet
• If flexion contracture, serial splint weekly into extension.
• When extension is at 0 then start treatment protocol for chronic mallet.
X-lite mallet splint

Volar gutter mallet for open wound
Zone III
Boutonniere Deformity

- Secondary to closed trauma with acute forceful flexion of the PIP joint producing avulsion of the central extensor tendon and triangular ligament inserting onto the middle phalanx
- Laceration on the dorsum of the PIP joint (open boutonniere)
- Painful, tender and swollen PIP following blunt trauma should arouse suspicion of possible boutonniere.
- PIP joint dislocation, dorsal hand burns, Rheumatoid arthritis, Dupuytren’s contracture are other causes
- Splinting focuses on allowing the central slip to heal while permitting DIP joint motion and motion of the extensor mechanism over the PIP joint to decrease adhesions
Zone III Treatment Boutonniere
Acute Injury

0-6 weeks post repair
• Splint PIP in full extension with a circumferential X-lite splint.
• AROM of the MCP and DIP joints of the digit in extension and flexion
  15 reps to each joint hourly
• Splint is worn continuously
• Monitor skin integrity

6 weeks post repair
• Begin AROM to the PIP joint and composite flexion. 15 reps hourly
• A sleeping volar splint for 2 additional weeks is made with PIP in full extension.

7 weeks post repair
• PROM to the PIP joint as needed
• If extension lag develops--- consult physician
Zone III Acute Boutonniere

- If PIP dislocation, as mechanism of injury, splint PIP in full extension for 2 weeks.
- If full active extension is not present, treat as boutonniere

X-lite boutonniere splint allows DIP AROM
Zone III  Chronic Boutonniere

0-8 weeks
• Circumferential X-lite splint with PIP in full extension for continual wear
• AROM to the MCP and DIP joint of the digit in flexion and extension
  Performed 15 reps hourly
• Monitor skin integrity

8 weeks
• Active and gentle PROM to the PIP joint. 15 reps of each hourly
• A volar PIP gutter splint is worn between exercises and while sleeping. Splint PIP in full extension
• Buddy tape for daytime use to increase flexion
• If extension lag develops – consult physician

10-12 weeks
• Focus on restoring flexion
• Splinting generally discontinued
• If flexion contracture of PIP joint, serial splint joint into extension. Change weekly. Start Chronic Boutonniere protocol when full PIP extension is achieved
Zone IV
- Injury over the proximal phalanx
- Broad configuration of tendon at this level
- Usually only a partial laceration due to this broad configuration

0-6 weeks post repair
- Splint PIP in full extension
- AROM to MCP and DIP joints 15 reps hourly
- Buddy tape beginning weeks 3-6. Continue to buddy tape for one month after the initial 6 week period.

6 weeks post repair
- PROM exercises are started
- Buddy tape to increase ROM
- Monitor for adhesions over the proximal phalanx
- Scar massage

8 weeks post repair
- Gentle strengthening is started
- ADL’s can be started between weeks 7 and 8
Zone V, VI and VII Extensor Digitorum Tendons

- Over MP joint (Zone V).
- Over dorsum of the hand (Zone VI).
- Over dorsum of the wrist (Zone VII) ("No mans land" in extensor tendon).
- Most often associated with open injuries.
- Lacerations of the sagittal bands, collateral ligaments often repaired.
- Closed injury may be rupture of the sagittal bands.
- Consideration of the interconnecting juncturae tendinum.
- Splint all digits even with single repair of EIP or EDM.
- Splint must position wrist in full extension 60-90°. MCP’s flexed 40-60°.

- If you splint the MCP’s in full extension and the tendon adheres you will have MCP extension contractures and stuck tendons--- A double whammy.

- Zone VII and VIII may require dynamic splint secondary to fibro-osseous tunnel and extensor retinaculum. Consult surgeon.
Zone V and VI and VII Digital Extensor Tendons

0-3 weeks post repair
- Splint in volar wrist splint which extends to include the proximal phalanx. Block the proximal phalanxes only. Wrist in max extension (60°). MCP’s in 40° flexion, IP’s free.
- AROM exercises to the PIP and DIP joints, 15 reps composite flexion hourly. Patient actively flexes until fingertip touches volar splint.
- Wound care and edema control.
- Scar massage once wound is healed for dorsal skin pliability.
- Patient education in no use of the hand in ADL’s.

3-6 weeks post repair
- Volar wrist cock-up splint, wrist in full extension, MCP’s and IP’s free.
- AROM exercises to the digits into full composite flexion and extension. 15 reps hourly.
- Buddy tape digits to promote tendon glide and to prevent/treat extensor lag for at least 4 weeks.
- Wrist AROM.
- Continue scar massage and edema control.
- Monitor for extrinsic tightness.
P 1 Block Splint

3 weeks post op
Volar wrist cock up
Wrist in max extension
Serial splint into flexion weeks 4-6

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Zone V, VI and VII Digital Extensor Tendons

6 weeks post repair
• Full AROM all joints
• Continue buddy tape until full motion is achieved
• Isolated extensor tendon exercises
• Composite finger flexion using graded dowels and associated wrist flexion
• PROM to wrist and digits
• Monitor for extension lag. If lag develops buddy tape

7-8 weeks post repair
• Wrist splint is discontinued
• Gentle progressive strengthening and full motion.
• Begin use of the hand in lightweight ADL’s < 1 #

10-12 weeks post repair
• Resistive strengthening exercises
Zone VII  Wrist Extensors only

0-3 weeks post repair
• Volar wrist splint wrist extended 60°.
• The elbow is included (LAS) & flexed to 90° if ECRL injury
• Active composite flexion and extension exercises 15 reps hourly
• Wound care as indicated and edema control
• Scar massage for dorsal skin pliability
• Patient education of no use of the hand in ADL’s

3-6 weeks post repair
• Begin serially splinting wrist towards neutral position of the wrist
• ECRL repair is placed in volar wrist splint
• Remove splint for AROM of the wrist. Perform in gravity eliminated plane of 0-full wrist extension 15 reps hourly
• Monitor for extrinsic tightness
• Overstretching of the wrist extensors can reduce grip by ½
• Discontinue splint at 6 weeks post repair
Zone VII Wrist Extensors

6-8 weeks post repair
- Add increments of wrist flexion, radial and ulnar deviation
- Begin use of the hand in ADL’s at 7-8 weeks

8 weeks post repair
- Full AROM
- Begin resistive strengthening

9-12 weeks post repair
- Patient can resume full use of the hand and return to work by weeks 10-12
Zone VIII

- Site of injury in dorsal forearm
- Commonly associated with musculotendinous avulsion or laceration to the muscle belly
- Common problem is extrinsic tightness
- Splint same as Zone VII wrist extensors only
- If ECRL is involved will require splinting of the elbow in $90^\circ$ of flexion for 3 weeks. At 3 weeks discontinue the long arm splint and fabricate a volar wrist cock-up splint.
Long Arm Splint for Extensor Tendon Zone VIII
**Thumb Zone T-I**

**0-6 weeks post repair**
- Circumferential X-lite mallet splint with IP joint in full extension or slight hyperextension
- AROM exercises to the MP joint 15 reps hourly
- Wound care progressing to scar massage

**6-8 weeks post repair**
- Monitor for extensor lag
- Volar splint for night-time wear X’s 2 weeks
- Pinch and grip strengthening can begin
Thumb Zone T-II and T-III  EPL/EPB

0-3 weeks post repair
• Volar wrist splint with thumb post is made with wrist in radial extension: Thumb CMC in extension and the MCP flexed to 40°
  IP joint of thumb is left free
• Wound care and edema control
• PROM to thumb IP joint
• AROM to the uninvolved digits
• Patient education in no use of the hand in ADL’s
• Scar massage to increase dorsal skin pliability

3-6 weeks post repair
• Volar wrist splint with wrist extended 30°
• Begin AROM of the thumb 15 reps hourly
• Remind patient of no pinching with the thumb
• Continue scar massage
Extensor Pollicis Longus/Extensor Pollicis Brevis Zone T-II and T-III
Thumb Zone T-II and T-III EPL/EPB

6 weeks post repair
• Discontinue volar wrist splint
• Scar massage
• PROM to thumb and wrist. Monitor for extensor lag
• Composite thumb and wrist flexion exercises

7 weeks post repair
• Patient can begin using thumb and hand in prehensile ADL’s

8 weeks post repair
• Light resistive pinch and grip exercises
Thumb Zone T-IV and T-V

0-3 weeks post repair
- Volar wrist splint with wrist extension of $30^\circ$, CMC in extension and MCP in $30^\circ$ of flexion. Volar portion of the thumb post allows for IP joint ROM to $60^\circ$.
- Thumb active IP flexion with passive IP extension, 15 reps hourly
- Wound care and edema control
- Scar massage
- AROM of uninvolved digits

3-6 weeks post repair
- Volar wrist splint
- Active Thumb ROM
- Scar massage

6 weeks post repair
- Splinting discontinued
- Gentle graded strengthening exercises
- Composite thumb and wrist flexion exercises
Thumb Zone T-IV and T-V

7 weeks post repair
• Patient can begin using the hand in ADL’s. No resistive pinching

8-10 weeks post repair
• Progressive strengthening of grip and pinch
Treatment Goals Post-Operative

- Provide protective splinting per extensor tendon zone of repair
- Instruct patient in range of motion per zone of injury per protocol.
- Prevent gap formation
- Wound care management
- Edema reduction techniques
- Instruct patient in no use of the involved hand and in one handed ADL’s (first 3 weeks)
- Scar massage to improve scar pliability, decrease adhesions
- Monitor for extension lag, treat
- Begin AROM
- Strengthen when appropriate to return grip and pinch strengths to normal and functional levels for ADL’s
- Increase use of involved hand in the performance of daily living tasks to promote independence
References


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