Extensor Tendon Repair and Rehabilitation

Surgical Indications and Considerations

*Anatomical Considerations:* Because of their superficial location, the extensor tendons are often involved with injuries to the dorsum of the hand and are very likely to form adhesions with injuries to the bone. The extensor tendons are thin, broad and flat in structure and, therefore, are vulnerable to rupture. The extensor tendons receive their blood supply through vascular mesenteries – mesotendons – that are analogous to the vincula of the flexor tendons. Synovial diffusion, which provides 70% of the nutrition, is the major nutritional pathway for the extensor tendons beneath the extensor retinaculum. Extensor tendon injuries are defined by seven zones for the extrinsic finger extensors and five zones for the thumb extensors. The zones are as follows:

<table>
<thead>
<tr>
<th>Zone I  – area from the DIP joint to the fingertip</th>
<th>Zone VII  – over the wrist</th>
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<tbody>
<tr>
<td>Zone II  – encompasses the middle phalanx</td>
<td>Zone TII  – extends from the IP joint to the tip of the thumb</td>
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<tr>
<td>Zone III  – over the PIP joint</td>
<td>Zone TIII  – lies over the MP joint of the thumb</td>
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<tr>
<td>Zone IV  – encompasses the proximal phalanx</td>
<td>Zone TIV  – encompasses the first metacarpal</td>
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<tr>
<td>Zone V  – over the MP joint</td>
<td>Zone TV  – is over the wrist at the thumb</td>
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*Pathogenesis:* Extensor tendon injuries are common because of their superficial location and lack of overlying subcutaneous tissue. Lacerations, crush injuries, avulsions, burns, blunt trauma, and deep abrasions are common mechanisms of injury. Associated fractures are common with extensor injuries in the digits. Attrition with delayed rupture from excessive friction over bony prominences is not uncommon, such as with rheumatoid arthritis.

*Epidemiology:* There are limited studies on epidemiology of extensor tendon injuries. There is a higher incidence in males than females. Industrial accidents and heavy labor accidents are common. The extensor tendons can also be injured in trauma, as in a Motor vehicle accident and crush injuries.

*Diagnosis*

- Mechanism of injury
- The exact position of a cut will indicate which structures may have been injured
- Assessment of passive movement of the digits
- Assessment of active movement of the digits and wrist – loss of active extension may be indicative of extensor injury
- Radiographs to assess for associated fracture
- Surgical exploration of the wound
Nonoperative Versus Operative Management: Not all extensor tendon injuries require surgery. Closed ruptures of the extensor tendons and partial lacerations respond well to splinting, unless there is an associated fracture. Open injuries and complete lacerations typically require surgical intervention to restore function.

Surgical Procedure: Surgery is usually performed as soon as possible. If there is infection associated with the injury, repair is delayed for 7-10 days until absence of infection is ensured. Delay in treatment can make repair difficult because the tendon can retract. Surgical repairs vary depending on the zone of injury and the thickness of the extensor. For DIP repairs, a running stitch that includes the skin is recommended. For mid and proximal phalanges, a running suture oversewn with a cross stitch is recommended. Extensor tendon repairs for central slip lacerations and injuries at or proximal to the level of the MP joint can be repaired using core sutures. For zone IV repairs, MGH (augmented Becker) repair has proved significantly more resistant to gap formation (stronger and tougher) than the Bunnell and Krackow-Thomas repairs. Chronic tendon injuries, often from attrition, can be managed with an intercalary graft or a tendon transfer. Tendon grafting can be performed with a palmaris longus or toe extensor. The surgeon should apprise the therapist of the quality of the repair, the type of repair, alterations in tendon length, the integrity of the tissue, the status of surrounding tissues, and any additional pathologic conditions that might alter the amount of controlled stress that the healing tendon can accommodate.

Preoperative Rehabilitation

- Edema and pain management
- Bracing for support and decreased risk of contractures
- Patient education and rehabilitation plan

POSTOPERATIVE REHABILITATION FOR ZONE V AND VI INJURIES

Note: The following rehabilitation progression is a summary of the guidelines provided by Hunter JM, Mackin EJ, and Callahan AD. Refer to their book, Rehabilitation of the Hand: Surgery and Therapy, to obtain further information regarding rehabilitation of extensor tendon repairs.

Phase 1 for Immobilization method: Weeks 0-3

Note: Total immobilization method may be necessary for the very young or noncompliant patient and may be acceptable treatment for the simple injury for a period of three weeks.

Goals: Prevent tendon rupture and promote tendon healing
- Edema and pain control
- Scar management
Intervention:

- Splinting – volar – wrist 40-45 degrees extension, 0 to 20 degrees of MP flexion, and 0 degrees or IP flexion
- Assessment of digital joints for stiffness
- Wound care
- Edema control, use of modalities
- MP joint protective ROM: therapist supports wrist and IPs in full extension, while gently moving the index and middle finger MPs from slight hyperextension to 30 degrees flexion, and the ring and small finger MPs from slight hyperextension to 40 degrees flexion
- PIP and DIP joint protective ROM: therapist supports wrist and MPs in full extension, while passively moving each individual PIP and DIP joint through complete range of motion. If PIP and/or DIP motion is limited, the immobilizing splint is cut away, allowing full PIP and DIP motion while maintaining wrist and MPs in full extension. A removable volar component may be applied sleeping and/or intermittently during day to prevent PIP joint flexion contracture and/or extensor lag

**Phase II for Immobilization method:** Weeks 3-6

Goals: Continue edema and pain control
- Initiate AROM
- Control extrinsic extensor tightness

Intervention:

- **Week 3**
  - Splinting – volar – wrist 20 degrees extension, MPs 0 degrees extension. With PIP extension lag or flexion contracture, use removable volar component. With MP joint flexion less than 30 to 40 degrees with a “hard” end feel – initiate dynamic MP flexion splinting to achieve 30 degrees flexion at index and middle and 40 degrees flexion for ring and small fingers. IP static extension splints can be used during active MCP joint exercise
  - MP AROM and AAROM with tenodesis: MP extension with wrist in neutral to slight flexion. MP flexion (40 to 60 degrees) with wrist in full extension
  - IP AROM, AAROM, PROM through complete range, while wrist and MPs are supported in full extension

- **Week 4 - 6**
  - Splinting – dynamic MP flexion as needed. Combination of MP and IP traction may be initiated to decrease extrinsic extensor tightness
  - Composite MCP/IP flexion with wrist extension
  - Individual finger extension
  - Isolated EDC extension
**Phase III** for *Immobilization* method: Weeks 6-12

Goals: Initiation of strengthening  
Return to previous level of functioning  
Full AROM and PROM

Intervention:

- Splinting – only as needed  
- Composite finger and wrist flexion, initiated when no extension lag present  
- Mild progressive strengthening including wrist flexion/extension and forearm pronation/supination  
- Weeks 10-12 – begin strong resistive exercises

**Phase I** for *Early Passive Motion* method: Day 1-7

Goals: Prevent tendon rupture and promote tendon healing  
Edema and pain control  
Encourage tendon gliding while minimizing tendon gapping and extensor lag  
Prevent adhesions

Intervention:

- 24 hours to 3 days postoperative  
- Splinting – two part dynamic splint. *Dorsal component*: wrist – 40 to 45 degrees static extension; MPs and IPs – 0 degrees dynamic extension. *Interlocking volar component*: MPs – permits active flexion of 30 degrees for index and middle and 40 degrees for ring and small fingers.  
- While maintaining IP extension, patient actively flexes digits at MCP joints until fingers touch volar splint. Patient releases digits, allowing extension loops to passively extend MPs to 0 degrees. Repeat this 20x’s each hour  
- Wrist tenodesis – The joints are moved passively in supervised therapy sessions with simultaneous maximum wrist extension and MP flexion to 40 degrees, followed by simultaneous wrist flexion to 20 degrees with all digital joints held at 0 degrees  
- Wound Care  
- Edema control  
- Splint adjustments  
- Controlled passive IP motion
Phase II for Early Passive Motion method: Weeks 3-6

Goals: Continue edema and pain control
  Initiate AROM
  Control extrinsic tightness

Intervention:
  • Splinting
    o Day: volar block splint removed. Continue with dorsal dynamic splint.
    o Night: wear volar static splint (adjusted to 30 to 45 degrees wrist extension and 0 degrees MCP/IP extension)
  • Modalities, dynamic splinting, and exercise the same as management by immobilization from the 3 week period onward

Phase III for Early Passive Motion method: Weeks 6-12

Goals: Initiation of strengthening
  Return to previous level of functioning
  Full AROM and PROM

Intervention:
  • Same as immobilization method.

Selected References:


