Common Extensor Tendon Problems
LAGS: Rupture, Attenuation, Adhesions

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Extensor Lag: 

Active is less than passive extension 

Ruptured, Adherent (STUCK), Attenuated (GAP/STRETCHED), or altered extensor anatomy
Differential Diagnosis:
Is there Full Passive PIPJ extension?

- YES

↓

- Low median/ulnar nerve deficit

Differential Dx:
Is there Full Passive PIPJ extension?

YES ➔ Resolve flexor muscle tendon unit tightness
Differential Dx:
Is there Full Passive PIPJ extension?

YES → Is there a motor learning impairment?

NO → Resolve Deficits to allow for examination of extensor function

Differential Diagnosis:
Is there Full Passive PIPJ extension?

• Resolve Deficits to allow for examination of extensor function
**Differential Dx:**
Achieve PIPJ passive extension

1. Resolve PIPJ capsular, Volar plate and ORL tightness
2. Identify changes to the joint (OA, Joint injury)

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It **IS** an EXTENSOR LAG
TAKE HOME

Understand **CLINICAL EXAM TECHNIQUES** to distinguish among **rupture, adherence or attenuation** of the extensor system at the PIPJ level, apply to other levels.

TAKE HOME

Identify Three **TREATMENTS** to prevent or treat an extensor lag.
Why is it important to PREVENT THE LAG?

• Delayed treatment for the ruptured extensor is less successful

• Surgical reconstruction for the attenuated extensor has less than desirable outcomes.

• Although an extensor tenolysis for adherent tendon has more predictable outcomes.

GENERAL CONSIDERATIONS

• Position tendon repair site proximal to its normal resting position during first 3 weeks of healing
  – Minimizes stress at repair site
  – Decreased chance of gap formation
  – Avoids elongated tendon callus which adversely impacts tendon function especially in zones with small excursions
LAG DUE TO RUPTURE

Is the Central Slip Ruptured?
A cadaveric analysis of Special Tests (Rubin 96)

• Difficult clinical diagnosis with closed injuries due to lateral band substitution.
• Cut central slip, triangular ligament and interosseous insertion
• To evaluate central slip, need to reduce the effectiveness of the lateral bands
Evaluate for RUPTURE

1. **Elson:** PIPJ in 90 deg flexion, PIP and DIP active extension
2. + Increased rigidity of DIPJ extension: LEFT
3. Not appropriate post repair

Reliable test

Tests that were NOT as reliable:

- Boyes
- Carducci
- Smith tenodesis
Evaluate for RUPTURE

• Resisted extension
• NMES

Support for Sonographic evaluation

• Retrospective review of 28 digits after surgical repair: Accuracy 96%, Sensitivity 100%, Specificity 93% (Budovec 2006)
• 12 cadaver digits with transection of central slip vs. sham: Sensitivity and Specificity 100% (Westerheide 2003)
• Literature review: Supports sonographic testing.
  – (Soni)
"At Risk" Cases for Rupture

PIPJ dislocation and possible Central Slip Injury: PREVENTION

- **Assume** a central slip injury if direction of dislocation is unknown and exam cannot confirm intact central slip.
- Immobilize in full extension, reexamine in one week.
- **Diagnostic ultrasound**
Laceration: PREVENTION

• Relative motion MP flexion orthosis: lateral bands relax, long extensor pulls lateral band dorsally
• If IP extension is maintained...continue RMFO
Extensor inflammation

- Rupture - progressive vs. acute
- Attenuation due to synovitis or abrasion over bony surface.
- Adherence due to prolonged immobilization when inflammation is present.

Extensor Inflammation: PREVENTION

- Rest in full extension.
- Systemic medications
- Isometric extension and avoid composite flexion
UGH: RUPTURE PRESENT

Treatment dependent upon Zone and extent of rupture

Chronic boutonniere

- Serial cast until IP extension is full
- 8 weeks of PIP extension orthosis and DIP FULL flexion
- Relative motion flexion orthosis at least 8 weeks.
  - LaLonde 2015
LAG DUE TO ADHERENCE

Evaluate for ADHERENCE

- Also has LIMITED FLEXION
- LESS PIPJ and DIPJ passive flexion with wrist and MPJ in flexion compared to with wrist and MPJ extension
- PRECAUTIONS
"At risk" cases for ADHERENCE

• Extensor tendon repair
• Especially if treated immobilized
Extensor Repair Zone 3
PREVENTION

- SAM program \((Evans \ 92,95)\)
- Wrist flexed to 30, MP 0-10 flexion to
- Reduce resistance from flexors
- Interossei assist PIP extension
- Lumbrical neutralize resistance of FDP and assist PIP extension
- Less tension at central slip repair site

Extensor repair Zone 3
PREVENTION

- Proximal excursion of the extensor
- Titration of flexion based on active PIPJ extension, Single joint motion \(\rightarrow\) obtain 70 deg ISOLATED PIP flexion and no lag, before composite flexion, Defer testing PROM
Extensor Repair Zone 3
PREVENTION

- Zone 4: Relative motion
  - (Howell, 2005; Sharma 2006)

- Systematic review: Favorable for Early Motion (Talsma 2008, Newport 2005)
P1 incision or Fracture fixation

- Limited passive flexion
- Is the secondary DIP lag due to adherence or attenuation at the DIP?

P1 or MC CRPP/ORIF

Causes

- Fracture callous may become adherent to tendon
- Pin fixation may adhere tendon
- Incision over P1 causes adherence
P1 or MC CRPP /ORIF: PREVENTION

• Orthosis resting MPJ in flexion, PIPJ in full extension. Possibly limit PIPJ flexion to 30 deg for 3 weeks. Isometric PIPJ extension if fixation is stable.

P1 or MC CRPP /ORIF: PREVENTION

• When allowing unrestricted motion, active extension and isolated joint flexion before composite flexion. Delay composite passive flexion.

• Scar retraction with Active motion
Adherence Prevention

- Initiate active extension early
- Value of active extension at the zone of injury & quality of extension (avoid proximal substitution)
- Titration of flexion to prevent secondary attenuation (single joint)
UGH: Adherence Present

Prevent contractures
Glide and Strengthen intrinsic and extrinsic extension. “Find excursion”

UGH: Adherence Present

Extensor Acceleration (Brown 2006)

Tension Lateral bands through PASSIVE DIP Flexion, lateral bands aligned more dorsally
UGH: Adherence Present

Avoid Compensatory MP and DIP Hyperextension and focus on PIPJ extension

Resist extensor to increase force on adhesions

UGH: Adherence Present

Glide Lateral bands Passively

Adherence after Zone 3 SAM Program
- PIP flexion at 60 deg and work on DIP flexion to direct force to adherent lateral bands
(Gangatharam 2013)

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LAG DUE TO ATTENUATION

Evaluate for ATTENUATION

- Extensor is “too long”, usually NO limitation in flexion.
- NO DIFFERENCE in PIP and DIP passive flexion with wrist and MPJ in extension compared to with wrist and MPJ in flexion.
Suspect ATTENUATION
Gapped or Stretched

Injury to the extensor tendon

• Repair

• Tendon Sheath

• Hardware irritation to tendon

• Inflammation

Clinical Research Background

• Flowers, McClure, McFadden: (Case Study)
• “We hypothesized that the tendon repair site had become excessively lengthened, and we therefore discontinued all flexion stretching and emphasized active extension. Additionally, we rested the joint in extension”
Extensor Repair Zone 3

PREVENTION

• SAM program \((Evans\ 92,95)\)

• Edema collection under central slip increases moment arm of extensor...attenuation

• Reduce edema

• Rest in Zero deg. Extension to prevent healing in lengthened position. Remold orthosis as edema decreases.

Extensor repair Zone 3

• GRADUALLY wean orthosis when full motion is allowed. Return to use if attenuation increases.

• Dynamic Extension orthosis or taping for intermittent rest in extension if attenuation is developing. \((Bracks\ 2007)\)
UGH: Attenuation Present

REST, REDIRECT, LIMIT FLEXION
Why is it important to understand the difference?

- Interventions are DIFFERENT
- You can have BOTH problems in different zones

Clinical Pearls

- Link anatomy to clinical exam and muscle isolation exercises. Measure extension. “Find” position to maximize active PIP extension.
- Rest PIPJ in Zero extension, Return to immobilization if attenuation develops.
Clinical Pearls

• Begin mobilization by active extension, isometric, position other joints to allow for desired activation. Increasing active extension will ALLOW the extensor to glide, to allow for excursion into flexion.
• Titrate flexion based on absence of extensor lag.
• Educate patient about potential for attenuation

Some of the Clinical Photos
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If we have time….

**ZONE I & II**

**Mallet deformity**

- Injury to the terminal tendon insertion (bony and soft tissue)
- Transmission of tension to the central slip, leading to PIP hyperextension and swan neck deformity
ZONE I & II
DIP extension splints


ZONE I & II
Swan neck mallet

Block hyperextension for 2 wks
Can be 2 splints
ZONE I & II: PREVENT Attenuation

Initial exercise after orthosis removal:
ACTIVE EXTENSION
...NOT FLEXION

Only zone where composite flexion is LESS STRESSFUL than isolated joint flexion

ZONE I & II: PREVENT Attenuation

• Step down from orthoses

JHT, 2006 July Sept, 365: The Moon Sock
ZONE I & II: PREVENT Adherence

Direct extension to terminal tendon

Sagittal Band

Sagittal band

– Closed cylindrical “tube” surrounding MC head an MPJ
• stabilize the extensor tendon at midline
• Extends the MCPJ
Sagittal Band

- Radial sagittal band critical to alignment
- Wrist position does not influence
- Progressive instability over 45 deg. MP flexion

Catalano 2006, Peelman 2015, Merritt 2014

Sagittal band: Prevent adherence

More conservative

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ZONES V & VI: Immobilization

ZONES V & VI: EPM
Zones V&IV: Prevent adherence/attenuation

Scar retraction with EDC activation
Isolated MP motion before composite

ZONE VII: Prevent Adherence

- Wrist flexion-isolated
- Individual finger active extension
Immediate Repair and Early (PASSIVE) Mobilization of the Extensor Pollicis Longus Tendon in Zones 1 to 4

A. R. KHANDWALA, 2004

• 100 extensor pollicis longus (EPL)tendon injuries in zones 1 to 4
• There were 90% excellent and good results in the 72 patients who were followed-up and received therapy for 12 weeks. Except on the rare occasion when the repair ruptures
Dynamic splinting for repair of the first extensor compartment tendons

Chinchalkar S, JHT 2008: 21 (3) 292-296

Thumb Extensor: PREVENT ADHERENCE

Butler, Svens JHT 2005
Review of learning objectives

• How do you evaluate for a rupture, adherent and attenuated extensor system?

• What diagnoses could cause a lag?

• What are treatment techniques for adherence and attenuation?

Consequences for Imbalance