Wrist and Hand Injuries in the Athlete

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Agenda

• Common Wrist and Hand Injuries in the Athlete
• Mechanism of Injury
• Anatomy
• Classification
• Management
• Rehabilitation
Common Wrist and Hand Injuries in the Athlete

Flexor Tendon Injuries
• Jersey finger

Extensor Tendon Injuries
• mallet finger
• boutonnière deformity

UCL injuries to MCP joint of the Thumb
• skier’s thumb

Rehabilitation Exercises for the Wrist and Hand
Flexor Tendon Injuries

Zone 1: Jersey finger
Flexor Tendon Injuries
Zone 1: Jersey finger

Mechanism of injury

The classic mechanism, for which the injury is named, is forceful hyperextension of DIP joint with maximal Flexor Digitorum Profundus (FDP) contraction.
Flexor Tendon Injuries

Zone 1: Jersey finger

Anatomy

Flexor Digitorum Profundus (FDP) originates on the upper ¾ of the anterior and medial surfaces of the body of the ulna, interossues membrane and deep fascia of the forearm.
Flexor Tendon Injuries

Zone 1: Jersey finger

Anatomy

The FDP travels through the Flexor Digitorum Superficialis (FDS) on its way to the base of the 2\textsuperscript{nd} through 5\textsuperscript{th} distal phalanges.

The Flexor tendons are held in place by five Annular Pulleys and three cruciform ligaments and receive their blood supply from the vincular system.
Flexor Tendon Injuries
Zone 1: Jersey finger

Diagnosis:

Flexor Digitorum Profundus
flexes the DIP joint
Inability to flex the DIP joint identifies injury to the tendon
Flexor Tendon Injuries

Zone 1: Jersey finger

**Classification**

**Type 1:** FDP tendon retracts into the palm and the vincular blood supply of the tendon is disrupted. (Requires urgent repair)

**Type 2:** FDP retracts to the level of the PIPJ with blood supply preserved (amenable to delayed repair up to 6 weeks)

**Type 3:** large bone fragment avulsed with tendon. Retraction to level of A4 pulley
Flexor Tendon Injuries
Zone 1: Jersey finger

Treatment

Surgical repair is technically demanding, especially for the retracted tendon. Care must be taken to minimize trauma to the annular pulleys. The flared out stump of the avulsed tendon may need to be trimmed to pass it through the A4 pulley.
Flexor Tendon Injuries
Zone 1: Jersey finger

Treatment

Tendon is anchored to the distal phalanx by passing sutures through the phalanx and tying them to a button placed the nail plate dorsally.
Flexor Tendon Injuries
Zone 1: Jersey finger

Rehabilitation

- Dorsal blocking splint
- Wrist flexed 30-40 degrees
- MCPs flexed 70 degrees
- IPs at 0 degrees
Flexor Tendon Injuries
Zone 1: Jersey finger

Rehabilitation

Early Passive Motion

Day 3 - Week 3
• Within the confines of the splint the digits are passively flexed and actively extended to the hood of the splint 6-8 times every waking hour
• The aim is to prevent joint stiffness and to passively move the tendon 3-5mm within the synovial sheath
• Coban bandage for edema control
Flexor Tendon Injuries
Zone 1: Jersey finger

In Theory:

- **Early passive motion** pushes tendon proximally and active extension pulls the tendon distally.
- This movement prevents tendon adhesion within the synovial sheath and provides nutrition to the tendon through synovial perfusion.

But in Fact:

- Cadaver studies suggest that the tendons may only buckle and not migrate proximally leading to adhesion formation.
Flexor Tendon Injuries
Zone 1: Jersey finger

Rehabilitation

Tendon Excursion Assessment

Week 3

• Warm up with passive ROM
• Initiate gentle active assisted flexion exercises
• Observe differences between PROM and AROM
Tendon Excursion Assessment

Flexor Tendon Repair

AROM = PROM
Proceed with Caution

AROM < PROM

Joint Stiffness
  - Work on PROM

Adhesions
  - Work on AROM

Gap Formation
  - Rupture Likely
Flexor Tendon Injuries
Zone 1: Jersey Finger

The task of the therapist:

Is to design a treatment program where a 3-5mm tendon excursion can be assured without undue stress to the repair.
Pyramid of Progressive Force Exercises

- Resisted Isolated Joint Motion
- Resisted Hook & Straight Fist
- Resisted Composite Fist
- Discontinuation of Protective Splint
- Isolated Joint Motion
- Hook & Straight Fist
- Active Composite Fist
- Place & Hold
- Passive Protected Flexion & Extension

Internal Tendon Load in Neutons:
- 0.1-3N
- 3-9N
- 4-20N
- 10-13N
- 29N

Tendon Excursion:
- undefined
- 2-10mm
- 5-17mm
- 23-33mm

Flexor Tendon Injuries

Zone 1: Jersey Finger

Hook Fist  Straight Fist  Isolated Joint Motion
Flexor Tendon Injuries

Zone 1: Jersey Finger

Depending on the tendon excursion assessment, the protective splint may be discontinued as early as 3 weeks for the severely adherent tendon and as late as 12 weeks for individuals with no appreciable lag.
Extensor Tendon Injuries
Extensor Tendon Injuries

Zones of Injury

Zone 1:
- DIPJ injuries
- Mallet finger

Zone 3:
- PIPJ injuries
- Boutonniere deformity
Zone 1: Mallet Finger

**Mechanism of Injury**

Rupture of the terminal extensor tendon at its insertion into the distal phalanx (*with or without associated fracture*)

Caused by sudden flexion of the extending DIP joint.
Zone 1: Mallet finger

**Anatomy**

The Radial and Ulnar lateral bands merge to form the terminal tendon.

Unlike the flexor the extensor tendons over the middle phalanx are held in place by their anatomic connections to the intrinsic muscles. Rupture to the tendon does not cause retraction.
Zone 1: Mallet finger

**Anatomy**

Posture of the DIPJ is very sensitive to changes in the length of the terminal tendon.

*Lengthening of the tendon 1mm results in a 25 degree extension lag*

*0.5 mm in a 10 degree lag*
Zone 1: Mallet finger

**Classification**

**Type 1:** Closed injury with or without small dorsal avulsion fracture

**Type 2:** Open injury-laceration

**Type 3:** Open injury with loss of skin, subcutaneous cover and tendon substance

**Type 4:** Mallet fracture

- a) Trans epiphyseal fracture in children
- b) Hyper flexion injury with # of articular surface of 20-50%
- c) Hyperextension injury with fracture of articular surface >50% (associated with volar subluxation of the distal phalanx)
Zone 1: Mallet finger

Management

Type 1: *Closed injury with or without small dorsal avulsion fracture*

- Splint DIPJ in slight hyper extension for 6-8 weeks leaving the PIP free
- Gradually wean from splint with night use only for 4 weeks
- Late presentation still amenable to successful splint management

Type 2: *Open injury-laceration*

Managed same as Type 1
Zone 1: Mallet finger

Management

Type 3: open injury with loss of skin, subcutaneous cover and tendon substance

- Soft tissue coverage may be necessary
- Open injuries allow for visual inspection of tendon
- Splint as in Types 1 & 2
Zone 1: Mallet finger

Management

Type 4a: Trans epiphyseal fracture (*most common in children*)
Extensor tendon sits on epiphysis
Flexor tendon on the metaphysis
Nail plate may be avulsed beneath the eponychial fold
If open, injury should be irrigated and treated with antibiotics

Surgery to repair repair nail plate and stabilize fracture longitudinal Kirschner wire
Zone 1: Mallet finger

Management

Type 4b: Hyper flexion injury with fracture of 20-50% of articular surface
  • Splint in extension 6-8 weeks
  • Avoid hyper extension as it may encourage volar subluxation of distal phalanx

Type 4c: Hyper extension injury with fracture >50% of articular surface (associated with volar subluxation of the distal phalanx)
  • Surgeon choice between splinting and Kirschner wiring
Zone 1: Mallet Finger

Management

Methods of immobilization vary:
• Custom molded thermoplastic splints (my preference)
• Aluminum foam splints
• Premade plastic splints
Zone 1: Mallet Finger

Critical Points

- X-ray: large articular fractures may require surgical management
- Splint DIP in slight hyperextension 24/7 for 6-8 weeks, leave PIP free
- Inspect daily for soft tissue breakdown
- Further 4 weeks of night time splinting
- **10 degree residual extensor lag is common**
Zone 3: Boutonnière deformity

Mechanisms of injury

• Blunt trauma to dorsum of PIP joint
• Volar dislocation of PIPJ resulting in an avulsion of central slip
Zone 3: Boutonnière deformity

Anatomy

- Central slip injury results in PIP extensor lag and DIP hyper extension
- Deformity is not immediately present
- Deformity presents 2-3 weeks post injury as the triangular ligament is stretched and the lateral bands migrate palmarly
Boutonnière Deformity
The Elson Test

- PIP flexion creates slack in the lateral bands allowing full DIP flexion and causing loss in power of active DIP extension
- Injury to the central slip eliminates the slack in the lateral bands and allows for extensor tension and active DIP extension
- Ability to extend DIP in PIP flexion is sign of central slip injury
Boutonnière deformity

**Treatment**

*For closed injuries*

- 6 weeks of static PIPJ extension splinting leaving DIP joint free
- Followed by a further 4 weeks of night splinting
- DIP flexion exercises are performed in PIP extension multiple times a day from the outset
Boutonnière deformity

Rehabilitation

After 6 weeks of immobilization a short arc of motion protocol is employed to facilitate tendon glide without undue stress to the healing tendon

- *Flex wrist 30 degrees to decrease the work of the extensors by putting the digital flexors on slack*
- *Have the patient bend fingers 30 degrees to touch a cylinder and then extend the PIP and DIP joints*
Boutonnière deformity

Critical Points

• Recognize the injury using the Elson test
• Splint PIP joint in full extension for 6 weeks
• Perform active and passive DIP joint flexion exercises hourly to stretch out the lateral bands
Ulnar Collateral Ligament (UCL) injuries of the Metacarpophalangeal (MCP) joint of the Thumb
Skier’s Thumb
Ulnar Collateral Ligament (UCL) injuries of the Metacarpal phalangeal (MCP) joint of the Thumb

Skier’s Thumb

**Mechanism of injury**

- Sudden, forced radial deviation of the proximal phalanx
- Often from a fall on an outstretched hand with an abducted thumb
- Common injury amongst skiers with falls while gripping ski pole, handle hyper abducts the thumb
- Seen in volleyball players trying to block opponents spike, and in football players when hand is hit by football or when throwing arm is hit after release of ball
Ulnar Collateral Ligament (UCL) injuries of the Metacarpophalangeal (MCP) joint of the Thumb

Skier’s Thumb

**Anatomy**

Thumb MCP joint primary motion is flexion and extension with minor abduction and adduction and supination and pronation.

The ROM of the thumb MCP joint is the most variable of any joint in the human body with some individuals having as much as 90 degrees of flexion and other with as little as 20.

Large curvature of the base of the proximal phalanx provides little intrinsic stability.

The Collateral ligaments are tight in flexion and loose in extension the accessory ligaments are the opposite, tight in extension and loose in flexion.

The floor of the joint is supported by the volar plate ligament with additional support coming from the thenar muscles that insert into the pair of sesamoid bones that are embedded in the distal volar plate.
Ulnar Collateral Ligament (UCL) injuries of the Metacarpophalangeal (MCP) joint of the Thumb

Skier’s Thumb

Classification

- **Grade I**: pain with stress, no laxity
- **Grade II**: pain with stress, laxity but firm end feel
- **Grade III**: no pain with stress, grossly unstable, no end feel

In complete UCL tears the adductor aponeurosis may become interposed between the distally avulsed ligament and its insertion into the base of the proximal phalanx. In such cases the ligament will never heal properly and the joint will remain unstable. This is a Stener lesion and requires surgical intervention.
Ulnar Collateral Ligament (UCL) injuries of the Metacarpophalangeal (MCP) joint of the Thumb
Skier’s Thumb

Classification

Patients with UCL injuries will have tenderness, bruising, and swelling. In MCP flexion they will have at least 15 degrees more laxity compared with the contralateral thumb. With complete tears the MCP joint can be opened without any end point.

A normal, B slight angulation, C rupture, D Stener lesion.
Ulnar Collateral Ligament (UCL) injuries of the Metacarpophalangeal (MCP) joint of the Thumb
Skier’s Thumb

Management

- Partial ruptures can be managed by a 6 week period of continuous immobilization of the MCP joint in a short thumb spica splint leaving the IP joint free
- At the 4 week point the splint may be removed for gentle active exercises
- At 6 weeks resistance exercises can be introduced; pinching, pulling, twisting, tearing and rolling of putty,
- Return to sport is expected by the 12-14 week mark
- Some degree of pain will likely linger for 6 months to a year
Skier’s Thumb

Critical Points

• No end feel means complete rupture, possible Stener lesion
• Short thumb spica for 6 weeks
• ROM at 4 weeks
• 12-14 weeks until full unprotected activity
Rehabilitation Exercises of the Wrist and Hand

In rehabilitating the injured wrist and hand many of the exercises overlap. The underlying aim of the therapy session is to facilitate normal movement while protecting the injured structures from unnecessary stress.

Hand therapists usually use the following exercises to accomplish this task:

- Contrast Baths
- Tendon Glides
- Passive Stretches of the digits and of the forearm muscles
- Grip strengthening exercises
- Forearm strengthening exercises
- Scapular stability exercises
- Proprioception exercises
Rehabilitation Exercises of the Wrist and Hand

**Contrast Baths**
- Hot water soak for 1 minute
- Cold water shock for 10 seconds
- Back and forth 5 hot/4 cold

Vasodilation from the hot and vasoconstriction from the cold improve circulation, facilitate movement and reduce pain.

Best done before exercise

**Tendon Glides**
- Taught as a lubrication exercise not as a strengthening or stretch exercise
Rehabilitation Exercises of the Wrist and Hand

**Passive Stretches of the digits**

- Stretch the intrinsic muscles of the hand
- Stretch the volar plates of the PIP joints
- Stretch the MCPs into flexion and extension
- Stretch hand into a composite fist

*Good passive stretch regime will reduce the work of the contractile tissues and prevent unwanted stumbling blocks such as trigger fingers and carpal tunnel syndrome*
Rehabilitation Exercises of the Wrist and Hand

**Passive Stretches for the wrist joint and the forearm musculature**

- Wrist joint best stretched with elbow flexed to reduce tension on the forearm musculature and focus stress on the wrist joint capsule
- Long flexors of the digits best stretched with elbow, wrist and digits extended and forearm supinated
- Wrist extensors stretched in elbow extension, wrist and digital flexion and forearm pronation
Rehabilitation Exercises of the Wrist and Hand

**Grip strengthening exercises**

Start with grip strengthening before wrist flexor or extensor strengthening

Grip strength requires good wrist flexion and extension strength

Squeezing water from a wet rolled up towel provides adequate resistance, satisfaction from observing affects and messy enough that patients unlikely to over do it

*Unlike with most other prescribed strengthening exercises Patients tend to exceed the prescribed repetitions and frequency when given Grip as an exercises*
Rehabilitation Exercises of the Wrist and Hand

*Strengthening exercises for the wrist and forearm*

Start with isometric exercises and progress to concentric and eccentric exercise
Have patients start resisted exercises once daily, 2 sets of 7 repetitions
Progress weekly as tolerated

ie; for Wrist flexors:
with the appropriate weight in hand, start with the wrist in maximal extension and flex through the available wrist flexion and then in a controlled fashion return the wrist to maximal extension

*Follow the same concept for wrist extension, radial and ulnar deviation and supination and pronation*
Rehabilitation Exercises of the Wrist and Hand

**Proprioception exercises**

Joint position sense:
*the ability to accurately reproduce a specific joint angle actively or passively*

Kinesthesia:
*the ability to sense motion of a limb*

Neuromuscular control:
*the ability to maintain joint stability and equilibrium*
Joint Position Sense

*Ability to accurately reproduce a specific joint angle*

Using a mirror, the patient tries to match the involved wrist with and uninvolved wrist in a predetermined target position

*This exercise is used to help normalize conscious control of the wrist*
Kinesthesia

the ability to sense motion of a limb

The patient is asked to close their eyes. The wrist is then moved passively and slowly until the patient signals that their wrist has been moved.

This exercise is used to help normalize conscious control of the wrist.
Neuromuscular control

the ability to maintain joint stability and equilibrium

Perturbation training destabilizes the joint sufficiently to elicit a stabilizing response without putting the wrist at risk of further injury

This exercise requires unconscious activation of wrist muscles to maintain stability
Neuromuscular control

the ability to maintain joint stability and equilibrium

The patient is instructed to make small circles with the wand

This exercise requires unconscious activation of wrist muscles to maintain rotation
Neuromuscular control
the ability to maintain joint stability and equilibrium

Plyometric training exposes the joint to destabilizing forces that elicit an appropriate stabilizing force response

This exercise requires unconscious activation of wrist muscles to produce a stabilizing force
In Summary

**Jersey Fingers:**
- Urgent repair needed for tendons that retract to the palm
- Early referral for therapy can minimize tendon adhesion
- Tendon excursion assessment by week 3 to identify adhesions

**Mallet Fingers:**
- X-ray: large articular fractures require surgical management
- Splint DIP in slight hyper extension 24/7 6-8 weeks, leave PIP free
- Inspect daily for soft tissue breakdown
- Further 4 weeks of night time splinting
- *10 degree residual extensor lag is common*

**Boutonnière Deformity:**
- Recognize the injury using the Elson test
- Splint PIP joint in full extension for 6 weeks
- Perform active and passive DIP joint flexion exercises hourly to stretch out the lateral bands

**Skier’s Thumb:**
- Physical exam!! No end feel means complete rupture, possible Stener lesion
- Short thumb spica for 6 weeks
- ROM at 4 weeks
- 12-14 weeks until full unprotected activity
Thank you


References


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