MR: Finger and Thumb Injuries

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Outline

• Normal anatomy of the fingers and thumb
• MR imaging protocols
• MRI findings of sports injuries of the fingers and thumb
NORMAL ANATOMY
Zone specific Anatomy (Verdan)-distal to proximal

retinacular ligament
oblique fibers
transverse fibers
interosseous muscle
sagittal band

Central slip

Extensor Tendon
Conjoined tendons

Extensor Tendon
Extensor Tendon

Transverse retinacular ligaments

Cleland's lig.

Grayson's lig.

Neurovascular bundle
Flexor Pulley System Injury

- Flexor tendons pass through a fibro-osseous canal
- Extends from the head of the metacarpals to the DIP joints
- 2 thumb pulleys – A1 and A2
Flexor Pulley System Injury

- A2 and A4
  - Largest
  - Prevent bowstringing
Flexor Pulley System Injury
Magnetic Resonance Imaging

- Coil selection - critical to quality imaging of the hand and fingers
- Small extremity coil
- AKA - elbow coil
Magnetic Resonance Imaging

- Small loop coil
- AKA Digit coil
- Allow very small FOV
Finger Positioning

Double Oblique Positioning
FLORIDA HOSPITAL MRI
GE 1.5T EXCITE/TWINSPED FINGER

CCIL: DUAL COIL

PRESCRIBE IMAGES RELATIVE TO FLEXOR TENDON: USE SMALLEST FOV POSSIBLE

### FINGER: ROUTINE

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**Use coronal if med/lat tumor, use sagittal if dorsal/palmar tumor**
Trauma
Finger and Thumb Injuries

- Very common in athletes
- 9% of all sports-related injuries
- Hand is characteristically in front of the athlete
- Absorbs the initial contact
Finger and Thumb Injuries

• Hands are used in a majority of sports
• Many competitive team sports
  – Fingers and thumb - most often injured
Fingers and Thumb Injuries

- Common in sports with a high risk of falling
  - Skiing
  - Biking
  - Gymnastics
  - In-line skating
Fingers and Thumb Injuries

- In-line skating –
  - >50% of injuries involve hand/wrist
- Football –
  - Hand and wrist injuries account for 15-20%
Finger and Thumb Injuries

• “Minor” injuries
  – Finger sprain
• “Major” injuries
  – Fracture or dislocation
• Hard to prevent
Imaging

- Radiographs
- Computed Tomography
- Magnetic Resonance Imaging
Hyperextension Injury
Capsular and Volar Plate Disruption
Hyperextension Injury
Capsular and Volar Plate Disruption

- **Volar Plate**
  - Thick fibrocartilaginous structure
  - Prevents hyperextension
  - Palmar aspect of PIP joint
  - Distal – firm attachment
Jersey Finger

- Disruption of the FDP from the volar base of the distal phalanx
- Finger is pulled or forced into extension while the DIP is actively flexed
Jersey Finger

- Attempting to grab someone by the jersey while making a tackle
  - Football
  - Rugby
- Ring finger - 75% of cases
- Localized pain and swelling
- Inability to flex DIP joint
Jersey Finger

- Radiographs or other imaging studies may be useful
- May depict a bony avulsion
  - Site of attachment of the FDP
  - Volar aspect of the base of the distal phalanx
Mallet Finger

- Occurs with forced flexion of the extended DIP joint
- Results in:
  - Stretching or tearing of the extensor tendon substance
  - Avulsion fracture
    - Extensor tendon insertion
    - Dorsal base of the distal phalanx
Mallet Finger

- Extensor tendon tear or bony avulsion
- Bony avulsion of dorsal base of the distal phalanx
Mallet Finger

- Classic mechanism of injury
  - Tip of the extended finger struck by a ball
    - Softball, baseball, or basketball
- Often referred to as a “Jammed” Finger
Applications:

Physeal Injury

• MR imaging accurately depicts the physeal anatomy

• Cartilage sensitive sequences are especially useful in mapping physeal bars
Flexor Tendon Zones

- I – between FDS and FDP attachments
- II – FDS attachment to palmar fold
- III – A1 pulley to retinaculum
- IV – carpal tunnel
- V – forearm proximal to retinaculum
Flexor Tenosynovitis

- MR imaging useful
- Increased signal within the tendon sheath
  - fluid sensitive sequences
- Enhancement
  - Post-gadolinium images
Flexor Tenosynovitis

- Cortisone injections – injected directly into the region of concern
- 90% improve with non-operative treatment
Tendon Evaluation

- Normal tendons demonstrate low signal intensity on all pulse sequence.
- MR accurately depicts tendon morphology and the gap for severed tendons.
- MR is also useful for pulley injuries.
Diagnosis

• Clinical Exam
  – Evaluation of FDS (examine individual because of separate muscle slip to each tendon)
Diagnosis

• Clinical Exam
  – Evaluation of FDP (Examine together since tendons share common muscle belly, FDP to index separate)
Diagnosis

• Clinical Exam
  – “Squeeze” test - squeeze volar mid-forearm and assess flexion of digits
Diagnosis

• Clinical Exam
  – Observation: “Cascade effect” of digits
  – Evaluation of FDS (examine individual because of separate muscle slips)
  – Evaluation of FDP (examine together since tendons share common muscle belly)
  – “Squeeze” test: squeeze volar mid-forearm and assess flexion of digits
  – Tenodesis effect: fingers should flex with passive wrist extension
Flexor Digitorum Profundus Avulsion

- Often missed or ignored because flexion at PIP and MCP still intact
- Young male athlete, ring finger most common
Flexor Tendon Tears

- Commonly result from sports-related injuries
- May occur anywhere along the course of the tendons
- Localized pain and swelling
- Inability to flex the IP joints
Flexor Tendon Tears

- Often difficult to diagnose and fully characterize clinically
- MR imaging - a noninvasive technique to identify:
  - Site of tear
  - Degree of retraction of torn fibers
Flexor digitorum profundus and superficialis rupture
Flexor Digitorum Profundus Avulsion

• Leddy and Packer classification:
  – Type I: Tendon retracts into palm- repair within 7-10 days

Courtesy of Dr. Peter Murray
Flexor Digitorum Profundus Avulsion

- Leddy and Packer classification:
  - Type II: Small bony fragment avulsed-usually trapped proximally at A3 pulley-repair in first 6 wks possible

From Strickland J, Green’s Hand Surgery
Flexor Digitorum Profundus Avulsion

- Leddy and Packer classification:
  - Type III- large bony fragment avulsed- usually trapped at A4 pulley- ORIF

From Strickland J, *Green’s Hand Surgery*
Flexor Pulley System Injury

- Flexor pulley system is divided into:
  - 5 annular pulleys
  - 3 cruciform pulleys
- Numbered from proximal to distal
Flexor Pulley System Injury

- A2 pulley - most important to flexor tendon function
  - Injury typically begins with the A2 pulley
  - Followed sequentially by the A3 and A4 pulley
  - Rarely - A1 pulley
Flexor Pulley System Injury

- Injuries are seen in rock climbers and in other sports resulting in forced extension of a flexed finger
- Account for approximately 30% of all hand injuries in rock climbers

Flexor Pulley System Injury

• Crimp Position
  – DIP joints - extended
  – PIP joints – flexed
  – MCP joints – extended
  – Carpus – slightly extended
Flexor Pulley System Injury

- **Hanging Finger Position**
  - Flexed
    - DIP joints
    - PIP joints
    - MCP joints

Pulley Injury - Grades

- I – pulley strain
- II - A4 rupture or partial rupture A2/A3
- III – A2/A3 rupture
- IV
  - Multiple ruptures
  - Single rupture with lumbrical ms or collateral ligament injury

MRI (3T)

- A2 PULLEY RUPTURES
  - Sensitivity: 87.5 %
  - Specificity: 100 %
  - Positive predictive value (PPV): 100 %
  - Negative predictive value (NPV): 95.2 %
Reconstruct pulley

Courtesy of Dr. Peter Murray
Reconstruct pulley

Courtesy of Dr. Peter Murray
Reconstruct flexor tendon

Courtesy of Dr. Peter Murray

Reconstruct flexor tendon
Reconstruct flexor tendon

Courtesy of Dr. Peter Murray
THUMB
Normal anatomy thumb

Extensor pollicis longus/brevis
Normal anatomy thumb

flexor pollicis longus
Normal anatomy thumb
Normal anatomy thumb

flexor pollicis longus
Normal anatomy thumb

- Adductor aponeurosis
- Ulnar collateral ligament
Normal anatomy thumb

radial collateral ligament
IML = Intermetacarpal lig.
POL = Posterior oblique lig.
DRL = Dorsoradial lig.

ECRL = Ext. carpi radialis longus
APL = Abductor pollicis longus
Bennett fracture

- 2 part intra-articular fracture/dislocation of base of 1st metacarpal
  - Small fragment of 1st metacarpal continues to articulate with trapezium
  - Lateral retraction of 1st metacarpal by abductor pollicis longus
Rolando Fracture

• Originally described - Y-shaped 3-fragment fracture
  – Extended to the articular surface

• Today the eponym is widely used for any comminuted intra-articular fracture at the base of the thumb
Gamekeeper’s Thumb

- Disruption of the ulnar collateral ligament of the 1st MCP joint
- Result of an acute radial or valgus stress on the thumb
Gamekeeper’s Thumb

• Injury can occur in the form of:
  – An avulsion fracture
  – Isolated ligament rupture
  – Combined fracture and ligament tear
Gamekeeper’s Thumb

• Commonly referred to as “Skier’s Thumb”
• Most commonly seen in snow skier’s
• Fall holding a ski pole causing forced abduction and extension of the thumb
Gamekeeper’s Thumb

- Radiographs may be useful
- May depict a small avulsion fracture
  - Ulnar aspect of the base of the 1st proximal phalanx
  - Attachment of the UCL
Gamekeeper’s Thumb

- **Stress radiographs**
  - Neutral radiographs
  - Radiographs with abduction and extension
- **Greater than 30 degrees difference**
  - Abnormal - UCL disruption
Gamekeeper’s Thumb

- MR or MR arthrography –
- Accurately demonstrate the osseous and soft tissue structures about the MCP joint – Including the UCL
Gamekeeper’s thumb

- If the fracture fragment is nondisplaced - splinting of the thumb may lead to healing and restoration of joint stability
- In most patients surgical repair is preferable
Stener Lesion

- Torn UCL displaces superficial to the adductor aponeurosis
- Prevents spontaneous ligament healing
- 29% of UCL injuries
Stener Lesion

- **MR imaging can depict**
  - UCL
  - Adductor Aponeurosis
- **Operative intervention**
  - Normal anatomic apposition
  - Healing of the displaced UCL
Stener Lesion

- If a Stener lesion is present
- Only operative intervention
  - Normal anatomic apposition
  - Healing of the displaced UCL
RCL avulsion
Conclusion

• Knowledge of the mechanism of injury and various injury patterns of osseous and soft tissue injury may direct the appropriate imaging studies for the fingers and thumb

• Imaging features of infection

• Review of the most common benign and malignant tumors of the fingers and thumb