Anatomy & Injuries of the Pediatric Wrist

Mahesh Thapa, MD
Seattle Children’s
University of Washington
NO DISCLOSURES
Multi-site pediatric MSK conference, hosted by Seattle Children's and Cincinnati Children's

For information on how to join the conference, please contact Dr. Mahesh Thapa of Seattle Children's or Dr. Carl Merrow of Cincinnati Children's.

Videos

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Multisite Peds MSK Conference - Episode 6

Multisite Pediatric MSK Conference
Episode 6

Hosted by

Seattle Children's (Mahesh Thapa, MD)
Cincinnati Children's (Carl Merrow, MD)

Topics discussed:
1. Long standing JIA with intra-articular "rice bodies"
2. Conventional Osteosarcoma (US appearance)
3. High-grade surface osteosarcoma (chondroblastic type)
4. Femoral stress fracture (bilateral)
5. Granuloma annulare of forearm
6. Extensive venous malformation of upper extremity
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- Complete Anatomy App
Objectives

At the end of this session the audience should be able to:

1. Identify the components of the TFCC and other important wrist ligaments on an MRI.
2. Describe how to perform single and triple compartment wrist arthrograms.
3. Recognize and classify TFCC injuries
4. Evaluate the pediatric wrist for common injuries
WRIST EMBRYOLOGY
- Wrist bones start as a single carpal mass from mesenchymal condensation.
- Capitate is the 1st structure to appear as immature pre-cartilage
• Endochondral ossification
• Capitate ossific center develops first
TRIANGULAR FIBROCARTILAGE COMPLEX (TFCC)
TFCC - Function

- Stabilizes the DRUJ
- Transmits axial load between the carpus and the ulna,
- Stabilizes the ulnar aspect of the carpus.
TFCC – Articular Disc
TFCC - Dorsal

- Dorsal Radioulnar ligament
- Extensor Carpi ulnaris tendon and sheath
TFCC - Dorsal

Dorsal radioulnar ligament and extensor carpi ulnaris tendon
TFCC - Ulnar

- Triangular Ligament
  - Styloid insertion
  - Foveal insertion
  - Intervening ligamentum subcruentum

- Meniscal Homologue
- Ulnar Collateral ligament
TFCC ulnar styloid and foveal insertion and ligamentum subcruentum
TFCC - Ulnar

Different patient TFCC ulnar styloid and foveal insertion and ligamentum subcruentum
TFCC - Volar

- Volar radioulnar ligament
- Ulnotriquetral ligament
- Ulnolunate ligament
TFCC - Volar

Volar radioulnar ligament and ulnotriquetral ligament
TFCC – Arterial Supply

- Ulnar Artery
- Dorsal branch of ant. Interosseous artery
- Palmar branch of ant. Interosseous artery
INTRINSIC WRIST LIGAMENTS
(INTERCARPAL LIGAMENTS)
Intrinsic Wrist Ligaments

- Scapholunate ligament
  - DISI
- Lunotriquetral ligament
  - VISI (but needs damage to capsular damage – dorsal radiocarpal and dorsal intercarpal ligaments)
Scapholunate Ligament

- SLL strongest at dorsal aspect (ligamentous)
- Proximal zone is fibrocartilaginous and weakest and can undergo degenerative perforations
- Volar zone is ligamentous but thinner and separated by loose vascular connective tissue
Scapholunate Ligament

Dorsal scapholunate ligament

Volar scapholunate ligament
Scapholunate Ligament

Dorsal scapholunate ligament
Scapholunate Ligament

- Band-like dorsal membranous SL ligament
- Triangular central membranous SL ligament (with cleft)
- Trapezoidal volar membranous SL ligament
Scapholunate Ligament

- Band-like dorsal membranous SL ligament
- Triangular central membranous SL ligament
- Triangular/trapezoidal central-volar (intermediate between the two) membranous SL ligament
Lunotriquetral Ligament
EXTRINSIC WRIST LIGAMENTS
Extrinsic Wrist Ligaments

- Extrinsic wrist ligaments attach at the carpus but travel out of the carpus, whereas intrinsic wrist ligaments are located entirely within the carpus.
Extrinsic Volar Ligaments

- Volar ligaments are important stabilizers of the wrist
  - Radioscaphocapitate
  - Radiolunotriquetral
  - Short radiolunate
Extrinsic Volar Ligaments

Volar extrinsic ligaments; white = radioscapapitate yellow = radiolunotriquetral
Extrinsic Volar Ligaments

Normal Variation: different patients
Extrinsic Dorsal Ligaments

- Two main dorsal ligaments
  - Dorsal radiotriquetral
  - Dorsal intercarpal (intrinsic)
Extrinsic Dorsal Ligaments

Dorsal radiotriquetral (white arrow) and dorsal intercarpal ligament (yellow arrow); dorsal tubercle of triquetrum (arrowhead)
Extrinsic Dorsal Ligaments

Dorsal radiotriquetral (white arrow) and dorsal intercarpal ligament (yellow arrow); dorsal tubercle of triquetrum (arrowhead)
Extrinsic Wrist Ligaments

- Theumann, et al. emphasize the important role of extrinsic ligaments for carpal instability.
- Carpal instability depicted on radiographs seem to be related to the association between intrinsic and extrinsic ligament tears, rather than intrinsic ligament tears alone.
TFCC INJURIES
Wrist Arthrogram

• 1 or 3 compartment injection (I prefer 1)
  – Radioscaphoid joint
  – 25 g butterfly needle
• My arthrogram mixture
  – 15 cc NS
  – 5 cc Optiray 320
  – 0.1 cc Gadolinium
• Inject between 5 – 10 cc
Palmer Type 1A Tear

- Simple tear in the articular disc
- Relatively common
- Does not cause DRUJ instability
Palmer Type 1B Tear

- Tear of Triangular ligament (attachment to Ulna fovea or styloid process)
- Often results in DRUJ instability
- Tx: Immobilization or surgery
Palmer Type 1C Tear

- Tear of Volar ulnar extrinsic ligaments (ulnolunate and/or ulnotriquetral)
- Complete disruption is rare – requires high-energy trauma
- Most occur in combo with 1B and/or lunotriquetral ligament tears
- Generally managed conservatively
Palmer Type 1D Tear

- Avulsion of TFCC from Radius
- Usually occur with distal radius fracture at margin of the sigmoid notch
- Do not cause DRUJ instability if the reduction of fracture is adequate
Palmer Type 2 – Degenerative Injury

- ulnocarpal abutment syndrome
  - a - TFCC wear
  - b - TFCC wear with lunate and/or ulnar chondromalacia
  - c - TFCC perforation with lunate and/or ulnar chondromalacia
  - d - TFCC perforation with lunate and/or ulnar chondromalacia and lunotriquetral ligament perforation
  - e - TFCC perforation with lunate and/or ulnar chondromalacia, lunotriquetral ligament perforation, and ulnocarpal arthritis
TWO OTHER UNIQUELY PEDIATRIC WRIST INJURIES
12 yr old girl with wrist pain

14 yr old girl – different patient
Gymnast Wrist

- On MR imaging, there is edema on the metaphyseal and sometimes one the epiphyseal sides of the physis.
- Foci of cartilage infiltrate the metaphysis
- Bony bridging can result from epiphyseal trauma
Gymnast Wrist

• Majority of abnormality is in distal radial physis (rather than ulnar physis)
  – Ulnar physis loses growth potential earlier
  – Radius has much larger cross-sectional area (80/20)
  – Kids tend to be ulnar-negative (96/4)
12 yr old boy with wrist pain
Galeazzi vs. Galeazzi-equivalent Fx

• Galeazzi Fx are distal radial fractures at any level with associated dislocation of the distal radioulnar joint
• In kids, there can be ulnar epiphyseal avulsion because of the relative structural weakness of the pediatric physis (Galeazzi-equivalent)
References


• MR imaging of TFCC, what every radiologist need to know. C. Chong1, J. C. Kandathil2; 1Singapore/SG, 2Tan Tock Seng/SG DOI: 10.1594/ecr2013/C-1841 DOI-Link: http://dx.doi.org/10.1594/ecr2013/C-1841

• IFSSH Scientific Committee on Bone and Joint Injuries:
  • Distal Radioulnar Joint Instability.
  http://www.ifssh.info/2012_Bone_and_Joint_Injuries_Distal_Radioulnar_Joint_Instability.pdf
Thank You

thapamd@uw.edu