MRI of the Wrist Ligaments

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Disclosures

- No financial disclosures

- The off label use of gadolinium for MR arthrography will be discussed
Ligament – Definition
Oxford English Dictionary

Etymology: < Latin ligāmentum, < ligāre to bind.

a. Anything used in binding or tying; a band, tie; Surg. a bandage, ligature. Obs. in lit. sense.

b. Anat. One of the numerous short bands of tough, flexible, fibrous tissue which bind the bones of the body together. By extension applied to any membranous fold which supports an organ and keeps it in position.
Wrist Ligaments

• Full degrees of freedom of motion in the wrist determined by the “constrained” instability of the distal forearm and carpus
  • “ring” formation of the carpus
  • Ulnar sided ligaments for pronation/supination
    • No radial sided ligaments connecting distal radius and carpus
• Pain and impaired function can result from derangement
“Intrinsic” Wrist Ligaments
Radiocarpal joint

- Ulnotriquetral Ligament
  - TFCC to the proximal carpus (triquetrum) and secondarily to the distal ulna

- Scapholunate Ligament
  - Scaphoid to the lunate

- Lunotriquetral Ligament
  - Lunate to the triquetrum
TFCC – Ulnotriquetral Ligament

- Important stabilizer of the ulnar wrist
  - But tears may not lead to gross instability
  - Important source of pain

- Complete, partial and "split tears" significant
Triangular Fibrocartilage Anatomy
“Fovea” sign

S.C. Tay, K. Tomita, R.A. Berger
The “ulnar fovea” sign for defining ulnar wrist pain: an analysis of sensitivity and specificity
J Hand Surg Am 32(4) (2007), pp 438-44

SN 95.2%
SP 86.5%
Can you really see the UTL?
UT Ligament Split Tear

Called Prospectively
Diagnostic comparison of 1.5 Tesla and 3.0 Tesla preoperative MRI of the wrist in patients with ulnar-sided wrist pain
J Hand Surg Am, 33 (7) (2008), pp. 1153–1159

100% sensitivity at 3T

M.D. Ringler, B.M. Howe, K.K. Amrami, C.E. Hagen, R.A. Berger
Utility of magnetic resonance imaging for detection of longitudinal split tear of the ulnotriquetral ligament
J Hand Surg Am, 38 (9) (2013), pp. 1723-7

30-58% sensitivity 1.5 and 3T

UT L

<table>
<thead>
<tr>
<th>UT</th>
<th>SN 1.5T</th>
<th>SN 3.0T</th>
<th>SP 1.5T</th>
<th>SP 3.0T</th>
<th>Acc 1.5T</th>
<th>Acc 3.0T</th>
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<tbody>
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<td>UT</td>
<td>75</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>94.9</td>
<td>100</td>
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</tbody>
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CI, confidence interval; AUC, area under the ROC curve.
* Test for difference in AUC between readers.
TFCC – Foveal Attachment

- Foveal attachment
  - Often injured with UT ligment
  - Critical attachment for stability
  - High grade partial or complete tears equally significant
Patients generally imaged in pronation with some resistance ("superman position")

Can displacement of DRUJ on axial MRI represent foveal tears as on CT?

Measurement

Simplified measurement technique

Line spans sigmoid notch
Circle approximates articular curvature of ulna
Ulnar displacement = \( \frac{A}{(A+B)} \times 100\% - 50\% \)
DRUJ Displacement on MRI

- Greater than 15% displacement associated with complete foveal tears 100% of time
- However – over 50% of cases with foveal tears had less than 15% displacement
- Useful as a “check” for second look by radiologist?
  - Usually visually obvious
Pre and Post TFCC Reconstruction
Repaired Foveal Disruption

Pre – displaced DRUJ

Post – Normal Alignment
Scapholunate Ligament

- Normal C-shape makes assessment in a single plane challenging
- Dorsal and volar components are "true" ligaments
- Membranous portion less critical
Sensitivity, Specificity, and Accuracy
1.5T (n=70) vs 3.0T (n=32)

TFCC
SN 1.5T: 84.5
SN 3.0T: 93.8
SP 1.5T: 75
SP 3.0T: 87.5
Acc 1.5T: 82.9
Acc 3.0T: 90.6
P value 0.337
P value 0.393
P value 0.304

SL
SN 1.5T: 58.3
SN 3.0T: 83.3
SP 1.5T: 82.4
SP 3.0T: 92.3
Acc 1.5T: 78.3
Acc 3.0T: 90.6
P value 0.288
P value 0.236
P value 0.1309

LT
SN 1.5T: 30.0
SN 3.0T: 57.1
SP 1.5T: 94.9
SP 3.0T: 100
Acc 1.5T: 85.5
Acc 3.0T: 90.6
P value 0.583
P value 0.251
P value 0.475

UT
SN 1.5T: 75
SN 3.0T: 100
SP 1.5T: 100
SP 3.0T: 100
Acc 1.5T: 94.9
Acc 3.0T: 100
P value 0.105
P value 1
P value 0.225
If you see this:
SLIL is completely torn
Extrinsic ligaments are torn
Fixed carpal instability is present

In other words – no imaging is really required
MRI of SLIL

• “Tear” should be complete disruption of one of either the dorsal or volar portions – or both

• Complete tears often associated with small ganglia – usually dorsal

• Redundancy and partial tears may be difficult to identify/differentiate
Intact SLIL
Normal C shape

Called torn on MRI – intact at surgery
Normal SLIL 3T
SLIL Tear
Complete Tear, SLIL

1.5T

3.0T
SL “Contusion”
SL redundancy/patulous - intact
Look for subtle SLAC findings

- Useful secondary sign of SLIL incompetence

- DISI “posturing” of the lunate a sensitive sign

- Can be assessed on MRI with careful attention to relative alignment
DISI Posture versus Extension
Lunotriquetral Ligament

- Not actually part of the TFCC

- MRI has the worst sensitivity and specificity for the LT ligament

- Accuracy improved with 3T
LT – 1.5 v 3.0T

![Bar graph showing LT values for different conditions: SN 1.5T, SN 3.0T, SP 1.5T, SP 3.0T, Acc 1.5T, Acc 3.0T. The values are 30.0, 57.1, 94.9, 100, 85.5, and 90.6 respectively.](image-url)
LT Ligament Tear
TFCC intact, LT tear
LT tear

Called partial on MRI – complete at arthroscopy
MR Arthrography

• Can increase sensitivity for complete tears to near 100%

• Invasive?

• Conventional arthrography with injection critical
  • US guided injection less useful – loss of context
RC Joint Injection
SL tear visible on Arthro Only
MRI of Wrist Ligaments

- Highest resolution required
  - Always use your best tools
- Correlation with clinical history critical
- MR arthrography can improve sensitivity and specificity for SL and LT ligaments
Thank You for Your Attention!