Wrist and Hand Sonography with MRI Correlation

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Pathology:
- Joint effusion and synovitis
- Tendon abnormalities
- Nerve entrapment
- Ligament, cartilage, and osseous injury
- Cysts and masses

Joint Effusion:
- Radiocarpal joint
- Midcarpal joint
- Distal radioulnar joint

Arthritis: synovitis
- Synovial locations:
  - Joint recess, bursa, tendon sheath
- Hypoechoic compared to adjacent subcutaneous fat
  - May be isoechoic or hyperechoic
- Hyperemia: variable
  - Represents activity of inflammation
  - Decreased: treatment (even NSAIDS)

Backhaus M, Arthritis and Rheum 1999; 42:1232
Synovitis: rheumatoid arthritis

Sagittal Plane: Radiocarpal and Mid-carpal Joints

Synovitis: lupus

T1-weighted T2-weighted Post-contrast

Erosions

- US criteria:
  - Disrupted cortex, two planes
  - Adjacent synovitis increases specificity
- US better than radiographs\(^1\)
- 29% false-positive rate compared to CT\(^2\)
- 40% sensitivity\(^3\)

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1Lopez-Ben, et al. Skeletal Radiol 2004; 33: 80
2Finzel S. et al. Arth Rheumatism 2011; 63:1231
3Dohn UF M. Arthritis Res Ther 2006; 8:1
Rheumatoid Arthritis: digit

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Tenosynovitis: Rheumatoid Arthritis
- Extensor Tendons of Wrist

Tenosynovitis: seronegative
- Short Axis
- Long Axis
- Axial T2w
- Coronal T2w
- Axial post-gado

Tenosynovitis: rheumatoid arthritis
- ECU
- Short Axis
- Long Axis: color Doppler

de Quervain Tenosynovitis:
- Stenosing tenosynovitis
  - Overuse, primary care givers
- 1st dorsal wrist compartment:
  - Extensor pollicis brevis + abductor pollicis longus
- Ultrasound findings:
  - Thick synovial sheath
  - Tendinosis
  - Cortical irregularity, hyperemia

J Ultrasound Med 1997; 16:685
De Quervain’s Tenosynovitis

- EPB
- AbPL
- Radius

Long Axis
Short Axis

Axial PDw
Axial T2w

Flexor Carpi Radialis

- Courses volar to triscaphe joint (scapho-trapezium-trapezoid compartment)
- FCR tendinosis and tear
- Associated triscaphe osteoarthritis

Parellada et al. Skeletal Radiol 2006; 35:572

Pitfall Alert!
Pseudo-tendon Tear

- Multiple tendon fascicles
- Abductor pollicis longus
  - Incidence: 80%
  - Up to 4 fascicles
- Extensor pollicis brevis
  - Incidence: 7%
  - Up to 2 fascicles
  - May be absent
- “Lotus Root Sign”
  - Seen best distal to radius

Rousset et al. Radiology 2010; 257:427
Choi et al. Radiology 2011; 260:480

Extensor Pollicis Longus: tear

EPL
ECRB

Long Axis
Short Axis

Pitfall Alert!
Pseud-tendon tear

- Extensor carpi ulnaris
- 6th extensor compartment
- Short axis: hypoechoic cleft
- Due to ground substance in between two heads of extensor carpi ulnaris

Ali S et al. Skeletal Radiol 2015; 44:1735
Chisvaras MM et al. AJR 2014; 203:531

Choi et al. Radiology 2011; 260:480
Intersection Syndrome

- Distal forearm
  - 1st wrist compartment tendons (APB/EPL) cross over 2nd wrist compartment tendons (ECRB/L)
  - Swollen, possible edema
- Snapping with supination and pronation

From: AJR 2003; 181:1245

Intersection Syndrome

- 1st compartment
- 2nd compartment
- Long Axis
- Short Axis

Calcific Tendinosis: extensor carpi ulnaris

- ECU
- Pisiform
- Long Axis

Pulley Tear

- A2 and A4 pulleys: most important
- Sagittal image
  - Bowstringing
  - Hypoechoic edema / hemorrhage
- Dynamic evaluation*

*Radiology 2002; 222:755

A2 – 4 Pulley Injury

- Proximal Phalanx
- Middle Phalanx
- A2
- A3
- A4

Normal

A4 Pulley Injury: bowstringing

- Middle Phalanx
- A4

Normal: < 1 mm; incomplete rupture: 1 – 3 mm; complete: 3 mm

Trigger Finger:
- Stenosing tenosynovitis: A1 pulley
- Thick and hypoechoic pulley
- Hyperemia: 91%
- Tendinosis: 48%
- Tenosynovitis: 55%


Trigger Finger: A1 pulley

Case #1

Case #2

Extensor Carpi Ulnaris:
- 6th extensor wrist compartment
- Asymptomatic subluxation
  - Supination
  - Up to 50% out of groove
  - No tear or tenosynovitis

Lee KS et al. AJR 2009; 193:651

Dislocation: extensor carpi ulnaris

Short Axis
**Pitfall Alert!**

**Pseudo-subluxation**
- Extensor carpi ulnaris
- 6th extensor wrist compartment
- Asymptomatic subluxation
  - Supination
  - Up to 50% out of groove
  - No tear or tenosynovitis

Lee KS et al. AJR 2009; 193:651

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**Carpal Tunnel Syndrome:**
- Proximal median nerve swelling
  - Area: circumferential trace
  - Normal: < 6 mm²
  - Borderline: 9 – 12 mm²
  - Abnormal: > 12 mm²
    - 12.8 mm² = moderate (83% sens, 95% spec)
    - 14.0 mm² = severe (77% sens, 100% spec)

Peetrons et al. Sem Musculoskel Rad 2013; 17:28
Ooi et al. Skeletal Radiol 2014; 43:1387

**Carpal Tunnel Syndrome: proximal**
- Short Axis
- Axial T2w

**Carpal Tunnel Syndrome: distal**
- Short Axis
- Axial T2w

**Carpal Tunnel Syndrome**
- Notch Sign

Radius
Lunate
Capitate
Carpal Tunnel Syndrome

Median Nerve: how to measure
- Short axis
- Toggle transducer: defined borders
- Site of maximal enlargement
- Circumferential trace
- Inner border of hyperechoic epineurium

Carpal Tunnel Syndrome
- Compare areas:
  - Proximal: pronator quadratus
  - Distal: carpal tunnel
- \( \geq 2 \text{ mm}^2 = \text{carpal tunnel syndrome} \)
  - 99% sensitivity
  - 100% specificity
- > 6 mm\(^2\) = moderate
- > 9 mm\(^2\) = severe

\(^1\)Klauser et al. Radiology 2009; 250:1712
\(^2\)Klauser et al. Eur Radiol 2015; 25:2419

Postoperative Carpal Tunnel
- Discontinuous or thickened transverse carpal ligament
- Anterior displacement of transverse carpal ligament
- Median nerve size:
  - May decrease
  - Does not correlate with success

\(^1\)Lee CH et al. Ann Plast Surg 2005; 54:143
\(^3\)Naranjo A et al. Scand J Rheum 2010; 39:49

Bifid Median Nerve + CTS
- Carpal tunnel syndrome
- Increase in cross-sectional area of \( \geq 4 \text{ mm}^2 \)
- Intraneural hypervascularity: 95% accuracy in diagnosis of CTS

\(^1\)Klauser et al. Radiology 2011; 259; 808
\(^2\)Mallouhi et al. AJR 2006; 186:1240
Guyon’s Canal:

- Ulnar tunnel syndrome
  - Ulnar nerve compression
  - Accessory Abductor Digiti Minimi\(^1\)
    - Variant: up to 24% of wrists
  - Hypothenar hammer syndrome\(^2\)
    - Trauma
    - Ulnar artery thrombosis + distal emboli

\(^1\)AJR 1999; 172:1397
\(^2\)J Vasc Surg 1987; 5:838

Accessory Abductor Digiti Minimi

- Normal variant: 24%
- Origin: palmaris longus, flexor retinaculum, fascia
- Insertion: abductor digiti minimi
- Superficial to ulnar nerve:
  - Nerve compression
  - Uncommonly interposed

Hypothenar Hammer Syndrome

- Ulnar artery thrombosis
  - Level of hamate hook
- Distal emboli
- Post-traumatic

J Vasc Surg 1987; 5:838

Ulnar Nerve: cyclist wrist

- Sensory branch impingement between hook of hamate and bicycle handlebar

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**Scapholunate Ligament Tear**

- Normal hyperechoic ligament not seen
- Abnormal hypoechogenicity
- Wide scapholunate space
- Dynamic imaging: fist clench

AJR 2002; 179:523

**Gamekeeper's Thumb**

- Injury of the ulnar collateral ligament (UCL) of the thumb
  - Historically, chronic injury in Scottish gamekeepers
  - Frequently, due to acute MCP joint hyperabduction
  - Skier's thumb: up to 86% of thumb base injuries

Note: sliding of adductor aponeurosis with isolated interphalangeal joint flexion
Ulnar Collateral Ligament: thumb

- Normal
- Sprain
- Partial Tear
- Nondisplaced Complete Tear (+ fracture)
- Displaced Complete Tear (Stener Lesion)

Stener Lesion:
- Displaced proximal stump of torn UCL
  - Hypoechoic & round
  - Proximal to MCP joint
  - At proximal edge of adductor aponeurosis
- No tissue spanning MCP joint
- "Yo-yo on a string" sign
- Ultrasound: 100% accuracy


Stener Lesion: variations

Non-displaced full-thickness tear + fracture

Displaced Full-thickness Tears

Adductor Aponeurosis

"Yo-yo on String"
Stener Lesion: dynamic

Proximal Phalanx

1st Metacarpal

White arrows = adductor aponeurosis
Yellow arrows = Stener lesion

Stener Lesion

Proximal Phalanx

1st Metacarpal

Normal


Stener Lesion

Long Axis


Triangular Fibrocartilage:

- Normal: hyperechoic, difficult to see
- Abnormal:
  - Abnormal thinning <2.5 mm*
  - Complete absence
  - 68% sensitivity, 85% accuracy

*J Ultrasound Med 1998; 17:41

Triangular Fibrocartilage Tear

Coronal Arthrogram

Triangular Fibrocartilage Tear

Coronal Arthrogram
Scaphoid Fracture:
- Disruption of cortex
- Point tenderness
- Displaced radial artery: dorsal*
- Limited

*Clinical Radiology 1993; 48:398

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Soft Tissue Mass: wrist ganglia
- Most wrist masses are ganglion cysts
- Dorsal: scapholunate ligament
  - Not compressible (unlike joint recess)
- Volar: radial artery & flexor carpi radialis
  - Proximal from radioscapoid joint capsule

*Skeletal Radiol 1994; 23:201

Soft Tissue Mass: wrist ganglia
- Anechoic or hypoechoic
- Well-defined, lobular
- Joint or tendon sheath communication
- <10 mm: hypoechoic without posterior acoustic enhancement

Pitfall Alert!
Ganglion Cyst vs Dorsal Recess

Ganglion: not compressible
Recess: compressible

Sagittal with Wrist Flexion

Axial color Doppler

Ganglion Cyst: volar

Axial T2w

Take Home Points:

- Arthritis: emphasize synovitis
- Nerve: swelling at entrapment site
- Stener:
  - Proximal to MCP joint and aponeurosis
  - Dynamic imaging
- Ganglion cysts:
  - Volar at FCR and radial artery
  - Dorsal over SL ligament

Syllabus on line and other educational material:
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