Wrist and Hand Sonography with MRI Correlation
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Disclosures
• Consultant: Bioclinica
• Advisory Board: GE, Philips
• Book Royalties: Elsevier
• Not relevant to this lecture

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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: US and MRI

- Many studies limited
  - Clinical exam as gold standard
- Both US and MRI more sensitive compared to radiography
- Both can show activity of disease
  - US: color and power Doppler
  - MRI: enhancement
- US equal compared to MRI

Backhaus M, Arthritis and Rheum 1999; 42:1232

Synovitis: lupus

- T1-weighted
- T2-weighted
- Post-contrast

Erosions

- US criteria:
  - Disrupted cortex, two planes
  - Adjacent synovitis increases specificity
- US better than radiographs
- 29% false-positive rate compared to CT
- 40% sensitivity

Dohn UF M, Arthritis Res Ther 2006; 8:1

Rheumatoid Arthritis

- 2ndPIP
- 5thPIP
- 2nd MCP
Rheumatoid Arthritis

Erosions: US and MRI

- Many studies limited
  - Variable or absent gold standards
- MCP joints (CT as gold standard):
  - Radiography 19% sensitivity
  - MRI: 68% sensitivity
  - US: 42% sensitivity
- Limitations: access to erosions

Dohn UF M, Arthritis Res Ther 2006; 8:1

Rheumatoid Arthritis: digit

Pseudoerosions

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Tenosynovitis: Rheumatoid Arthritis

Extensor Tendons of Wrist

Tenosynovitis: rheumatoid arthritis

Short Axis Long Axis: color Doppler

Tenosynovitis: seronegative

Coronal T2w Axial post-gado

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 Tenosynovitis

EPB AbPL Radius
Long Axis Short Axis
Axial PDw Axial T2w

De Quervain Tenosynovitis

Short Axis Long Axis
Tendon Tear

- Hypoechoic or anechoic
- Disruption of tendon fibers
- Retraction: full-thickness
  - Dynamic imaging

Flexor Carpi Radialis

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

Extensor Pollicis Longus: tear

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

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

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

Ali S et al. Skelet Radiol 2015; 44:1735
Chiavaras MM et al. AJR 2014; 203:531
From: AJR 2003; 181:1245
Intersection Syndrome

Abnormal Normal

2nd compartment 1st

Short Axis

Long Axis

Calcific Tendinosis: extensor carpi ulnaris

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

A4 Pulley Injury: bowstringing

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

A2 Pulley Injury
Trigger Finger:

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


Boxer Knuckle:

- Damage to the sagittal bands of extensor hood
  - Transverse orientation
- Extensor tendon subluxation or dislocation with finger flexion

Lopez-Ben et al. Radiology 2003; 228:642

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

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

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

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

PQ Rad

Klauser et al. Radiology 2009; 250:1712
Naranjo A et al. Scand J Rheum 2010; 39:49

Klauser et al. Radiology 2009; 250:1712

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Klauser et al. Radiology 2009; 250:1712

Klauser et al. Radiology 2009; 250:1712
Bifid Median Nerve + CTS
- Carpal tunnel syndrome\(^1\)
- Increase in cross-sectional area of \(\geq 4 \text{ mm}^2\)
- Intraneural hypervascularity:
  \(95\%\) accuracy in diagnosis of CTS\(^2\)

\(^1\)Klauser et al. Radiology 2011; 259; 808
\(^2\)Maltouhi 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\(^3\)
    - 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

Timerson et al. AJR 1999; 172:1397

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

Ulnar Artery Aneurysm
- Hamate

Courtesy of EFW Radiology, Calgary, Alberta, Canada
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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 85% of thumb base injuries

**Ulnar Collateral Ligament: thumb**

**Note:** sliding of adductor aponeurosis with isolated interphalangeal joint flexion

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**Ulnar Collateral Ligament: thumb**

<table>
<thead>
<tr>
<th>Normal</th>
<th>Sprain</th>
<th>Partial Tear</th>
<th>Nondisplaced Complete Tear (+ fracture)</th>
<th>Displaced Complete Tear (Stener Lesion)</th>
</tr>
</thead>
</table>

Radiographics 2006;26:1007

**UCL: tears**

- Partial-thickness tear
- Full-thickness tear
- Normal

**Non-displaced full-thickness tear + fracture**

- 1st Metacarpal
- Proximal Phalanx

**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**

- Normal
- 1
- 2
- 3
- 4
- Non-displaced tear
- Displaced Full-thickness Tears
Stener Lesion

“Yo-yo on String”

Stener Lesion: dynamic

White arrows = adductor aponeurosis
Yellow arrows = Stener lesion

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
Triangular Fibrocartilage Tear

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

*Clinical Radiology 1993; 48:398

Scaphoid Fracture

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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


Soft Tissue Mass: wrist ganglia

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

*Skeletal Radiol 1994; 23:201
Ganglion Cyst: dorsal

Pitfall Alert!
Ganglion Cyst vs Dorsal Recess

Ganglion: not compressible
Recess: compressible
Sagittal with Wrist Flexion

Ganglion Cyst: volar

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: www.jacobsonmusks.com
Twitter handle: @jjacobson