Ultrasound of the Elbow, Wrist, and Hand

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Disclosures:
• Consultant: Bioclinica
• Advisory Board: Philips
• Book Royalties: Elsevier
• Not relevant to this talk

Pathology
• Elbow
  – Biceps and triceps
  – Epicondylitis
  – Ligament tears
• Wrist and Hand
  – Inflammatory arthritis
  – Tendon and pulley pathology
  – Gamekeeper’s thumb

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Biceps Brachii Tendon: complete tear non-retracted

Longitudinal: dynamic imaging
Kalume Brigido M. Eur Radiol 2009 ; 19:1817

Biceps Brachii Tendon: partial tear (short head)

Longitudinal:
Retracted superficial short head (yellow arrows)
Hypoechoic but intact deep long head (white arrows)

Biceps Tendon Tears: dynamic imaging

Partial Tear
Complete Tear

Triceps Tear:
- Muscle injury: contusion
  - Mixed echogenicity hemorrhage
- Distal tendon injury
  - Usually partial-thickness tear
  - Superficial aspect of tendon
  - Avulsion fracture of olecranon

Hematoma: triceps

Longitudinal

Anatomy of the Distal Triceps Brachii

- Superficial (blue arrow): long + lateral heads
- Deep (black arrow): medial head
  - Primarily muscular insertion

*From Resnick, Skeletal Radiol 2009; 38:171
**Triceps Tear: partial thickness tear**

- Superficial layer torn
  - Long and lateral heads
- Intact deep layer (medial head)
- Associated enthesophyte bone fragment
  - 1 – 2 cm in size
  - 2.5 – 4 cm retraction
  - No donor site

J Ultrasound Med 2011; 30:1351

**Triceps Tendon: partial tear + avulsion**

Muscle Injury: DOMS

- Delayed onset muscle soreness
- Type 1 muscle strain
- Pain after intense physical activity:
  - Microtrauma: inflammation and edema
  - Onset: day 1, peak day 2-3, resolves day 7
  - Possible increased creatine kinase
- Upper extremity: triceps, biceps, brachialis
- Muscle enlargement with increased echogenicity


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**Epicondylitis:**
- Common flexor and extensor tendons
- Abnormal hypoechochogenicity
  - Mucoid degeneration, tendinosis
- Anechoic: partial-thickness tear
- No inflammatory cells*

*Potter, Radiology 1995; 196:43
Connell, AJR 2001; 176:777

**Common Extensor Tendon: elbow**
- Often called “tennis elbow” or “lateral epicondylitis” or “epicondylitis” or ……
- All terms are misnomers
- Those inflicted usually do not play tennis (professionally or correctly)
- It is not inflammatory
- It is not a primary problem of the epicondyle

**Common Extensor Tendon:**

![Image of common extensor tendon](image1)

**Common Extensor Tendon: tendinosis**

![Image of common extensor tendon tendinosis](image2)

**Common Extensor Tendon: epicondylitis**

![Image of common extensor tendon epicondylitis](image3)

**Common Extensor Tendinosis + RCL Tear**

![Image of common extensor tendon tendinosis + RCL tear](image4)

Note: normal radial collateral ligament (white arrow)
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**Collateral Ligament Tear**

- **Partial tear**: hypoechoic, thickened
- **Complete tear**: anechoic fluid tracking through ligament defect
- **Dynamic examination**: stress

Miller et al. Skeletal Radiol 2004; 33:386

**Ulnar Collateral Ligament Tear**

- T1w Coronal post-gadolinium
- T2w Coronal post-gadolinium

**Ulnar Collateral Ligament: partial tear**

**Ulnar Collateral Ligament**

- **Valgus stress**: 30 degrees elbow flexion
  - Unlock the olecranon
  - Stress the UCL anterior band
- **Gravity stress** is adequate, equal to Telos¹
- **Ultrasound measurements**:
  - Reliable and precise²


**Ulnar Collateral Ligament: valgus stress**

- >1 mm asymmetric gapping = 87% accuracy in diagnosis of UCL tear
- MR arthrography accuracy = 88%
- US + MR arthrography: accuracy = 98%
- Asymmetric joint space widening with stress:
  - Normal: 1.3 mm or less
  - Partial tear: 1.2 – 3.0 mm
  - Full thickness tear: 2.8 – 4.8 mm

Roedl JB et al. Radiology 2016
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Inflammatory Arthritis: role

• Identify synovitis and erosions
  – Prior to initiating treatment
• Determine activity: hyperemia
• Aspirate or inject
• Follow-up after therapy
  – Decreased hyperemia and synovial thickness
  – Lack of synovial thickness improvement at 3 months predicts progression*

*Chen YC et al J Clin Rheum 2017; 23:73

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: dorsal wrist

Sagittal Plane: Radiocarpal and Mid-carpal Joints
Rheumatoid Arthritis

Erosions

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

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

Pseudoerosions

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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

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

Flexor Digitorum Longus Avulsion and Pulley A4 Tear

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

Abnormal Normal Radius

1st compartment

2nd compartment

Long Axis

Short Axis

Pulley Tear

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

*Radiology 2002; 222:755

A2 and A4 Pulley Injury

Normal

Proximal Phalanx Middle Phalanx

A2 A4

A3

A4 Pulley Injury: bowstringing

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

Scapholunate Ligament Tear

At Rest Clench Fist

Normal

Extrinsic Dorsal Ligament Injury

Dorsal Radiotriquetral Ligament

Normal

Diagram from: Theumann Radiology 2003; 226:171
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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

Stener Lesion: variations

Ulnar Collateral Ligament: thumb

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

Sprain

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

Radiographs 2006;26:1007
**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


**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

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**Stener Lesion: dynamic**

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**Triangular Fibrocartilage Tear**
Triangular Fibrocartilage Tear

Take-home Points

- Epicondylitis: misnomer
- Inflammatory arthritis: focus on synovitis
- Dynamic imaging
  - Biceps tear
  - Ulnar collateral ligament
  - Gamekeeper’s thumb

Syllabus on line and other educational material: www.jacobsonmusk.com
Twitter handle: @jacobsn