Ultrasound of the Elbow: Diagnosis and Intervention

Jon A. Jacobson, M.D.
Professor of Radiology
Director, Division of Musculoskeletal Radiology
University of Michigan

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Pathology:
• Joint effusion and bursa
• Tendon abnormalities
• Ligament abnormalities
• Nerve abnormalities
• Soft tissue masses

Joint Effusion:
• Olecranon recess
• Displaced hyperechoic fat pad by anechoic / hypoechoic fluid
• Best place to look with US*
• More sensitive than radiographs*

De Maeseneer, Invest Radiology 1998; 33:117

Olecranon Recess: joint effusion

Joint Effusion: anterior elbow

Sagittal, lateral
Sagittal T1w
Radial Recess
Coronoid Recess
Capitellum
Trochlea
Ulna
Transverse
Sagittal, medial
Elbow Joint

- Olecranon recess
- Elbow flexed
- In plane
- Lateral to medial

Olecranon Recess

- Synovitis: seronegative arthritis
- Complex Fluid: septic

Septic Joint: Coccidiomycosis

- Over olecranon
- Anechoic or hypoechoic
- Well-defined
- Heterogeneous: complicated fluid

Olecranon Bursitis:

- Tendon Abnormalities:
  - Tendinosis: hypoechoic, enlarged
  - Partial-thickness tear: anechoic focus, no retraction
  - Full-thickness tear: discontinuity
  - Dynamic imaging: retraction

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Biceps Brachii:

- Insertion: radial tuberosity
  - Short head: superficial, distal
  - Long head: deep, proximal
- No synovial sheath
- Bicipitoradial bursa


Biceps Brachii: terminal bifurcation

Note: toggling the transducer, which creates anisotropy allows visualization of two tendon heads

Courtesy of M. Chiavaras, Hamilton, Ontario

Biceps Brachii Tendon: distal

1 = long head
2 = short head

Long Axis

Biceps Brachii Tendon: tendinosis

Medial Approach

Biceps Brachii Tendon: whole blood injection

Dorsal Flexor Pronation Position

Biceps Brachii Tendon: complete tear

Distal biceps stump

Normal
Biceps Brachii Tendon: complete tear

Long Axis  Short Axis

Biceps Brachii Tendon: complete tear non-retracted

Opposite

Biceps Brachii Tears:

- Diagnosis of full-thickness tear versus partial-thickness tear:
  - 95% sensitivity
  - 71% specificity
  - 91% accuracy
- Shadowing: important indirect sign of tendon retraction

da Gama Lobo et al., Am J Roentgenol 2013; 200:158

Biceps Brachii: short head tear

Yellow arrows = short head
White arrows = fluid around long head

Biceps Brachii: short head tear

Yellow arrows = tear of short head
White arrows = intact long head
**Bicipitoradial Bursa**

- Surrounds distal biceps
  - Does not communicate to elbow joint
  - No distal biceps tendon sheath
- If distended:
  - Mechanical, inflammatory
  - Characteristic "U" shape
  - Average: 1.8 – 2.5 cm in size
  - May displace deep branch of radial nerve

Skaf AY, Radiology 1999; 212:111

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**Bicipitoradial Bursitis**

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**Triceps Tear:**

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

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**Hematoma: triceps**

- Longitudinal

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**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

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**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 Tendon: partial tear + avulsion

Humerus
Intact deep fibers
Intact deep fibers

Long Axis (Sagittal Plane)
Olecranon Bone Fragment
Intact Medial Head

Common Extensor Tendon: elbow
- Often called “tennis elbow” or “lateral epicondylitis” or “epicondylosis” 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

Lateral Collateral Ligament Complex
- Radial collateral ligament (arrows)
- Common extensor tendon (E)
- Annular ligament (arrowhead)
- Lateral ulnar collateral ligament (curved arrow)


Common Extensor Tendon Removed
Note: normal radial collateral ligament (white arrow)
Common Extensor Tendon: PRP

Common Extensor Tendon: partial tear

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Common Extensor Tendinosis + RCL Tear

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Ulnar Collateral Ligament Tear

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
Ulnar Collateral Ligament

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

1Harada M et al. J Sho Elb Surg 2014; 23:561

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Ulnar Nerve: anatomy

- Behind medial epicondyle of humerus:
  - Cubital tunnel retinaculum or Osborn’s fascia
- Distal to epicondyle:
  - True cubital tunnel
  - Between ulnar and humeral heads: flexor carpi ulnaris
  - Under arcuate ligament


Ulnar Nerve: cubital tunnel syndrome

- Hypoechoic and enlarged
  - > 9 mm² area
  - Ratio greater than 2.8 compared to proximal
- Mild hypoechoegenicity alone: may be normal
- Causes:
  - Idiopathic, overuse, joint process
  - Anconeus epitrochlearis: compression
  - Normal variant accessory muscle

1Thoirs K et al. J Ultrasound Med 2008; 27:737
2Yoon JS et al. Muscle Nerve 2008; 38:1231

Cubital Tunnel Syndrome
**Ulnar Nerve: dislocation**
- 20% of asymptomatic volunteers
- Dynamic imaging:
  - Dislocates in anterior to medial epicondyle of humerus in elbow flexion
  - Reduces in extension (normal MRI)
- Transducer pressure may inhibit movement

Okamoto, J Hand Surg Br 2000; 25:499

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**Isolated Ulnar Nerve Dislocation**

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**Snapping Triceps Syndrome:** dynamic imaging

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**Radial tunnel**
- Radial nerve: deep branch
  - Originates from radial nerve between brachioradialis and brachialis
  - Passes between deep and superficial layers of supinator muscle
  - Exits as posterior interosseous nerve


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**Radial Nerve: deep branch**
- Supinator syndrome:
  - Motor deficits (wrist, finger extension)
  - Abnormal electrodiagnostic studies
  - Nerve enlargement: entrapment
- Radial tunnel syndrome:
  - Pain, no motor deficits, normal EMG
  - Muscle denervation on MRI
  - No nerve enlargement

Ferdinand BD et al. Radiology 2006; 240:161
Supinator Syndrome: deep br. radial nv.

Abnormal Normal

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Epitrochlear Lymph Node: hyperplastic

Cat scratch disease = infection
- Animal scratch: usually a cat
  - Bartonella henselae
- Child or adolescent:
  - Most common
- Elbow:
  - Lymphadenopathy
  - Epitrochlear lymph node (medial)

Take-home Points
- Joint: posterior, aspirate if concern for infection
- Bicipitoradial bursa: U shape
- Biceps and triceps:
  - Anatomy explains partial-thickness tears
- Nerves: don’t forget to look
- Dynamic imaging
  - Ulnar nerve dislocation, snapping triceps
  - Ulnar collateral ligament evaluation

Syllabus on line and other educational material:
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