MR Imaging of the Elbow

BIOMECHANICS

Osseous
- Humerus
- Radius
- Ulna

Three articulations:
- Ulnar-tochlear
- Radiocapitellar
- Proximal radioulnar

0-140 degrees flex/ext
75 pronation
80 supination

ANATOMY: NORMAL VARIATION

- Trochlear sulcus
- Posterior capitellar pseudodefect

DDx: location; no underlying edema

ANATOMY: NORMAL VARIATION

- Hematopoietic marrow at proximal radius

In phase 4.6 ms
Out of phase 2.3 ms

EFFUSION

- Difficult to see directly (cartilage thin)
- Subchondral marrow edema best sign
- Phytes-posterior/medial/coronoid -confirm cart loss/ cause impingement
- Associated with effusion and bodies

CARTILAGE LOSS

Fat pads are Intracapsular and extrasynovial

DDx:
- FRACTURE
- ARTHRITIS
- INTERNAL
  (e.g., ligament, cartilage)
Focal cartilage defect

INFECTION

INFLAMMATORY ARTHROPATHIES

Rheumatoid Arthritis

OSTEOCHONDRAL DEFECT
OCD capitellum with underlying fluid (unstable fragment)

**INTRAARTICULAR BODIES**
- Detection
  - CT arthrography
  - MR arthrography
  - Look for fluid surrounding questioned body
    - DDx synovial fold, extracapsular focus

**MR Arthrography**
- Spurs, bodies can lead to posterior impingement

**SYNOVIAL FOLD**
- Lateral plica syndrome
  - Posterolateral catching / locking
  - Cartilage wear

**ANATOMY**
- Ligamentous
  - Medial collaterals
  - Lateral collaterals
- Musculotendinous
  - Posterior: triceps, anconeus
  - Anterior: biceps, brachialis
  - Medial: flexor-pronator
  - Lateral: common extensor
- Neurovascular

**“EPICONDYLITIS”**
- Medial: golfer’s elbow (common flexor origin)
- Lateral: tennis elbow (common extensor origin)
- Increased T1 signal
- Increased STIR, T2 signal
- Focal fluid signal = tear
- Histologically: angioblastic changes/ fibrillar collagen degeneration
Partial tear of common extensor origin

Large tear

Partial tear extending down ECR

MEDIAL EPICONDYLITIS

BICEPS ANATOMY

- **Long head**: superior glenoid
- **Short head**: coracoid
  - Two heads merge distal to the bicipital groove
- **Insertion** onto radial tuberosity at elbow
  - Intimate with brachialis
- Proximal: synovial sheath
- Distal: paratenon, bicipitoradialis bursa and lacertus fibrosus
**Biceps Injury**

- **Proximal**
  - Older
  - "Decrepit"
  - Impingement
  - Much more common
  - No surgery (cuff maybe)
- **Distal**
  - Younger
  - "Lifts weights"
  - Bursitis
  - Surgery usually needed

**Biceps Pathophysiology**

- Degeneration
  - Primary (overuse injury)
  - Secondary (indirect - friction)
- Primary: Hypovascularity - no sheath, inefficient healing
- Secondary: Mechanical - pronation/supination leads to impingement between radius and ulna

**Biceps Tendinosis**

- Common, but rare to image
- Imaging/clinically overlap with partial tear, bursitis
- Very distal at insertion

**Bicipitoradialis Bursitis**

- Distal biceps lacks a sheath
- Apparent fluid is **bursal**
- Assoc with biceps tears (esp partial), RA

**Biceps Partial Tears**

- Attritional
- Pain
- No pop, usually no ecchymosis
- More marrow edema and bursitis
- Surgery not usually needed unless large
FABS (Flexed ABducted Supinated)

- Positions the biceps more easily in the plane of imaging

Giuffre BM, Moss MJ. AJR 2004; 182:944

Complete tear
Retraction
“popeye arm”

Lacertus fibrosus
- Extends from pronator fascia to biceps
- May prevent retraction of biceps tear

BRACHIALIS INJURY
Anterior capsule / brachialis tear
Elbow Dislocation
Ossification
**TRICEPS PATHOLOGY**
- Triceps: also no sheath!
- Risk factors: steroids, SLE, CRF, RA, gout
- Within 2-3 cm of insertion, usually **at**
- Associated olecranon bursitis
- Look for avulsion fx

**Triceps Tendinosis**
Intermediate signal = tendinosis

**Triceps Avulsion**
Bone fragment

**Triceps Tear**
Tendon tear

**Triceps tear with olecranon bursitis**

**OLECRANON BURSITIS**
- Anatomic bursa
- Normally no fluid visible
- Causes
  - Injury
  - Overuse
  - RA
  - Gout
  - Infection

Professional basketball player
Olecranon bursitis: Inflammatory
- DDx RA, gout, septic

Septic Bursitis with Osteomyelitis
- Bursa can extend far from olecranon
- Septic arthritis uncommon, even with osteomyelitis

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LIGAMENTS

- Medial
- Lateral

MEDIAL COLLATERAL LIGAMENT

- AKA ulnar collateral ligament (UCL)
- Three segments
  - anterior bundle
    - most important soft tissue static constraint to valgus stability
  - posterior bundle
  - transverse bundle

MCL partial tear
- “T sign”
MCL partial tear

MCL chronic partial tear: MR arthrography

Prior MCL tear with scar

FOOSH: Acute complete MCL tear

MCL complete tear on MRA

LIGAMENTS

• Medial
• Lateral
LATERAL LIGAMENTS
• Three main components
  - Lateral collateral ligament proper (LCL) (Radial collateral ligament)
  - Annular ligament
  - Lateral ulnar collateral ligament (LUCL)

Annular Ligament
• Fibro-osseous ring that encircles and stabilizes the radial head
• Attaches on the anterior and posterior edges of the lesser sigmoid notch
• Anterior portion taught in supination and posterior portion taught in pronation

ANNULAR LIGAMENT
RADIAL COLLATERAL LIGAMENT
• Extends from the lateral epicondyle and attaches to the annular ligament
• Immediately deep to the common extensors

Radial Collateral Ligament Tear
LATERAL ULNAR COLLATERAL LIGAMENT (LUCL)
• Posterior “hammock” for radial head
• Major stabilizer rotational and varus stress
Posterolateral Rotatory Instability

- Instability of the elbow manifested by painful clicking of the elbow in extension
- Radial head moves posteriorly in relation to the capitellum
- Essential lesion - tear of the LUCL
- Lateral pivot shift test
  - Supination with axial and valgus stress

LUCL Injuries

- Caused by a fall on an outstretched hand
- Iatrogenic injury during release or repair of lateral epicondylitis

MCL + LCL tear: = dislocation

OSSEOUS INJURY
**OSSEOUS INJURY**

- Effusion on X-ray: presumed fx
- F/U X-ray vs MR
- Bone bruise vs. fracture
- T1 is KEY!!
  - T1: linear low signal = fracture
  - No line, ill-defined edema = bruise

- Bone Bruises
  - olecranon
  - coronoid

- Occult fx – radial neck

- Radial head fx
  - slight depression

**AVULSION FRACTURE**

- Avulsion fx
  - Ligamentous or tendinous
  - Thin, longitudinally oriented edema at cortical margin

**OSTEOCHONDRAL IMPACTION**

- Analogous bruises from ACL tears
- Transient disloc/sublux
- Often both sides of joint
Osteochondral Impaction injury

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**NERVE IMPINGEMENT**

- Median/radial nerve branches
  - Ligament of Struthers / arcade of Froesche / impingement by muscle / fascia / scar
  - Radial tunnel syndrome
  - Anterior / posterior interosseous nerve syndrome
  - Pronator syndrome
  - Look for muscle edema distally

- Ulnar nerve: cubital tunnel
  - Nerve edema (can be normal)
  - look above and below (focal enlargement?)
  - Subluxation
  - Associated with epicondylitis, MCL injury

**ULNAR NERVE IMPINGEMENT AT THE CUBITAL TUNNEL**

- Cubital tunnel
  - Fibro-osseous tunnel next to medial epicondyle
  - Look for:
    - Increased T2 signal in nerve
    - Fascicular anatomy (“dots”)
    - Enlargement
    - Subluxation from groove
    - Distal muscle edema

**ULNAR NERVE IMPINGEMENT**

- Mass effect in tunnel
  - OA
  - scarring
  - synovial proliferation (RA)
  - Tumor
- Direct injury
- Extension of MCL, epicondyle injury
- Subluxation (torn / deficient transverse ligament)

OA with spurs in cubital tunnel
Ulnar nerve enlargement

**Anconeus Epitrochlearis**
Accessory muscle, can cause mass effect

Ulnar nerve
Anconeus
Anconeus epitrochlearis

**MUSCLES**

Pronator syndrome

Muscle edema

**Delayed Onset Muscle Soreness**

Note feathery pattern with muscle injury

Diffuse edema pattern
- Neurological disorder
- Brachial plexopathy
  (Parsonage-Turner Syndrome)
- Nerve impingement syndrome
Infection - Myositis
Note associated fasciitis

SOFT TISSUE MASSES AT THE ELBOW

Epitrochlear lymph node

Nerve sheath tumor

MR ARTHROGRAPHY

Elbow MRA
Elbow MRA

- Ligament tear
  - Extracapsular leakage of contrast
  - Medial or lateral collateral ligament tear
- IA bodies
  - Anterior, posterior recesses
- OCD
  - Same dx as knee
  - Esp capitellum

QUESTIONS?