Upper Extremity Imaging

What to Order and How to Interpret the Report

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Upper Extremity Imaging Outline

- Different modalities for imaging
- What to order
- Interpretation of reports

Why image?
- New injuries
- Chronic problems
- Rule out tumor

Imaging
- Aid diagnosis
- Determine significance
- Allow treatment plan
Different Modalities

- Radiographs
- Ultrasound
- CT scan
- Bone scan
- MRI

Pearls for Ordering Imaging

- Write down what you are concerned about
  - Xrays of wrist with concern of scaphoid fracture
  - MRI of shoulder with recurrent instability
- Radiologists can aid in getting the right studies for you
  - They can also suggest better studies

Plain radiographs

- Image obtained by projecting x-ray beams onto a detector
- The amount of ‘whiteness’ is a function of the radiodensity and thickness of the object
- Dense object – whiter image

Plain radiographs

- Good first line evaluation
- Need multiple views of a joint (AP and lateral)
What to order?

- Shoulder
  - AP glenohumeral joint
  - Axillary lateral glenohumeral joint

What to order?

- Elbow
  - AP/lateral elbow/oblique joint

What to order?

- Forearm
  - AP/lateral forearm

What to order?

- Wrist
  - AP/lateral/oblique wrist
What to order?

- Hand
- AP/ Lateral

What to look for?

- Fractures
  - Displaced
  - Comminuted
  - Impacted
- Arthritis
  - Mild, moderate, severe
- Abnormal morphology
  - Spurs, OCD, deformities

When to worry?

- Displaced fractures – always need attention
- Nondisplaced fracture – can immobilize
- Stress fracture/ cannot rule out....
  - Need secondary evaluation
  - Further imaging
  - Closer follow-up

Ultrasound

- Uses high-frequency sound waves to produce images
- Similar to sonar wave on getting images of the ocean
- Can be helpful to evaluate ganglion cyst
  - Wrist ganglions
  - Tendon ganglions
- Diagnose tendon tears
  - Rotator cuff tears
  - Rotator cuff repairs
Ultrasound

- Advantages
  - Non-invasive
  - Dynamic
    - Tendon instability
- Disadvantage
  - User-dependent
  - Cannot image deep tissue
  - Cannot image tissue within bone

Ultrasound

- Can use for targeted therapy
  - Ultrasound guided injections
    - Viscosupplementation for Glenohumeral joint
    - Calcific tendinitis
    - Intra-articular injection of the hip

CT scan

- Tomographic evaluation of the region of interest
- Good for 3D bony anatomy
  - Glenoid and humeral bone loss
- Complex reconstruction
- Post-traumatic injuries
  - Wrist malunion

CT scan

- Advantages
  - Tomographic evaluation
  - Gives detail in trabecular and cortical structures (better than MRI)
    - Measure bone loss
    - Evaluate fracture pattern
    - Evaluate healing
CT scan

- Disadvantages
  - Subject to metal artifact
  - Weight limit for obese patients
  - Higher radiation (1 CT = 229 Xrays)
  - Contraindicated for pregnant patients

Plain Radiographs

3D CT scan

CT Scan

- Hamate Fracture
Nuclear imaging

- Uses radioisotope-labeled biologically active drugs
- Radioactive tracers administered to the patient to serve as markers of biologic activity
- Images produced by scintigraphy
  - Technetium bone scan
  - FDG in PET scans
    - Measure glycolytic rates
    - Higher in tumor cells

Bone scan

- Rule out tumor – multiple lesions, increase update
- Infection – tagged WBC scan
- Evaluate symptomatic joints
  - Such as arthritis
  - Nonunion
  - Stress fractures

Nuclear medicine

- Advantages
  - Imaging of metabolic activity
    - Healed fracture or nonunion
    - Arthritis
  - Diagnosis of infection
- Disadvantages
  - Lack detail and spatial resolution
  - Limited early sensitivity
    - Fractures usually takes up to several days to show
    - Low sensitivity for lytic problems
    - Multiple myeloma

MRI

- Current gold standard for soft tissue injuries
  - Rotator cuff tears
  - Labral tears
  - Ligament tears
  - Cartilage injuries
- Uses a magnetic field to generate nuclear spin in hydrogen atoms
  - Relaxation times recorded as radiofrequency signal
MRI with contrast - Gadolinium

- Intra-articular contrast
- Distends the joint
- Enable evaluation of ligament and labrum
- Small rotator cuff tears
- Cartilage injuries, such as TFCC

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MRI - Gadolinium

- Intravenous contrast
- Evaluate vascularity
  - Tumor
  - Post-surgical changes, such as scar tissue
  - Concern with kidney insufficiency and complications

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MRI

- Helpful to evaluate cuff integrity
- Quality of muscle
  - Fatty infiltration
  - Retracted tear
- Labral pathology

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Rotator Cuff Tears

- Tear
OCD of the elbow

TFCC tear
- Triangular Fibrocartilage Complex

Scaphoid fractures

MR Arthrogram
- For younger patients
- Look for partial thickness RCT
- Look for delamination
- Look for labral pathology
MR Arthrogram- Elbow

- Look for intraarticular pathology, MCL tear loose bodies, OCD

MR Arthrogram- Wrist

- Evaluate ligament tears
- Look for communication between compartments

Interpretation of MRI Findings

MR Shoulder

- Asymptomatic individuals
  - > 60 y.o. – 54% have cuff tear (28% full, 26% partial)
  - 40 – 60 y.o. – 4% full, 24% partial
  - 19 – 39 y.o. – 0% full, 4% partial

Careful with Interpretations!!!
Treat the patient, not the MRI
MRI for Rotator Cuff Tears

- Size of tear
  - How many tendons?
- Retraction
  - How difficult will it be?
- Fatty Infiltration
  - How good will the repair be?
- Denervation
  - How well will recovery be?

Interpretation

- Rotator cuff tears
  - Age of patients
  - Older patients – common to have partial cuff tears
    - Conservative treatment
  - Full thickness cuff tears (esp young patient <65)
    - Referral for discussion of treatment

Labral Tears in Shoulder

- Anterior labral tears-
  - Instability, recurrent dislocations

Labral Tears

- Superior labral tear (SLAP) tear
  - Pain with overhead activity in young pt (<45)
  - Treated with PT and surgery if fails conservative treatment

- Degenerative labral tears in older pts (>50) are common
  - Likely incidental finding

- Weakness – not correlated with labral tears
AC Joint

- High signal in AC joint
  - Common MR reading
- AC arthritis
  - Clinical diagnosis
  - Superficial joint

MRI Elbow

- Evaluate ligament tear
- Cartilage injury
  - OCD
  - Loose bodies

MRI Wrist

- Ligament tears
  - Scapholunate ligament tears
  - Lunotriquetral ligament tears
- TFCC tears
- Bone AVN
  - Kienbock’s disease – lunate AVN

Radiology Reports – love adjectives!

- Fraying vs Partial tear vs Full thickness tear vs Retracted tear
- Cartilage in homogeneity vs fissure vs flap vs unstable flap vs full thickness cartilage loss
- Tendon degeneration vs tendinosus vs tear

Clinical Correlation Recommended…
What are they saying?

- There is adequate distention of the glenohumeral joint with intra-articularly administered contrast. High T2 signal in the anterior subcutaneous fat compatible with iatrogenic injection of anesthetic.
- OSSEOUS AND CARTILAGINOUS STRUCTURES: Nonspecific cystic changes at the greater tuberosity. There is no evidence of a fracture or dislocation. No focal chondral defects are identified.
- MUSCLE AND TENDON: Unremarkable. Normal signal and morphology of the biceps tendon. There is no thickening of the coracoacromial ligament.
- ROTATOR CUFF MUSCLES AND TENDONS:
  - Mild tendinosis of the supraspinatus tendon and anterior fibers of the infraspinatus tendon. Possible limited interstitial tearing of the posterior fibers of the infraspinatus tendon at the insertion (series 6, image 13).
  - Normal signal and morphology of the subscapularis and teres minor tendons.
  - Normal signal and bulk of the rotator cuff muscles.
- LABRAL AND CAPSULAR STRUCTURES: Irregularity of the anterosuperior and superior labrum compatible with degenerative changes. Blunting of the anterior labrum without discrete tear. No paralabral cyst formation.

**IMPRESSION:**
1. Irregularity of the anterosuperior and superior labrum compatible with degenerative changes. Blunting of the anterior labrum without discrete tear. The posterior labrum appears intact.
2. Mild tendinosis of the supraspinatus tendon and anterior fibers of the infraspinatus tendon. Possible limited interstitial tearing of the posterior fibers of the infraspinatus tendon at the insertion.

What are they saying?

- BICEPS TENDON AND ANCHOR: High T1 signal within the intra-articular portion of the long head biceps tendon favored to represent iatrogenic injection. The extra-articular portion of the long head biceps tendon demonstrates normal signal and morphology.
- OSSEOUS AND CARTILAGINOUS STRUCTURES: Non-specific cystic changes at the greater tuberosity. There is no evidence of a fracture or dislocation. No focal chondral defects are identified.
- MUSCLE AND TENDON: There are no intra-articular bodies. The remaining muscles demonstrate normal bulk with no evidence of atrophy or edema.

**IMPRESSION:**
1. 51 yo with fall and full thickness rotator cuff tears
   - Refer for treatment and repair

- CLINICAL HISTORY: 51-year-old male with right shoulder pain after fall, rule out full thickness rotator cuff tear
- OSSEOUS ACROMIAL OUTLET: Large inferior clavicular osteophytes indent the supraspinatus. Fluid is noted in the acromioclavicular joint with reactive marrow changes. Type 2 acromion.
- ROTATOR CUFF MUSCLES AND TENDONS:
  - Full thickness tear at the anterior footprint of the supraspinatus tendon with supraspinatus tendinosis. Fluid is noted in the subacromial/subdeltoid bursa. Rotator interval synovitis.
- LABRAL AND CAPSULAR STRUCTURES:
  - Unremarkable. No evidence of labral tears.
- MISCELLANEOUS: The inferior glenohumeral ligament is not well defined and thickened. Fluid is also noted in the subacromial/subdeltoid bursa. Rotator interval synovitis.

**IMPRESSION:**
1. Full thickness tear at the anterior footprint of the supraspinatus tendon with supraspinatus tendinosis.
2. Thickening of the inferior glenohumeral ligament as well as rotator interval synovitis may reflect adhesive capsulitis.

What are they saying?

- 55 yo with no trauma and above findings – AGE Appropriate changes

NORMAL FINDINGS with hooked acromion!!!

Pulmonary nodules – depends on history
May need further evaluation

What are they saying?

- 65 yo with shoulder pain – evaluate shoulder
- IMRESSION:
  - No evidence of acute fracture or dislocation. Degenerative changes of the acromioclavicular joint with a hooked type III acromion and inferiorly projecting osteophytes off the distal clavicle.
  - Mild/moderate degenerative changes glenohumeral joint as well as small marginal osteophytes.
  - Close approximation of the humeral head and the acromion with weightbearing suggest underlying rotator cuff pathology.

**NORMAL FINDINGS with hooked acromion!!!**

Pulmonary nodules – depends on history
May need further evaluation
What are they saying?

40 yo with acute elbow pain – concern with biceps rupture

FINDINGS:

MUSCLES AND TENDONS: An acute tear of the biceps tendon at its insertion on the radius is associated with approximately 5.5 cm of retraction of the proximal tendon and large amounts of T1 hypointense and T2 hyperintense fluid within the soft tissues of the anterior elbow.

The common flexor tendon is normal in signal and thickness.

The common extensor tendon is frayed and irregular and may be consistent with prior injury.

LIGAMENTS: The ulnar and radial collateral ligament complexes are intact.

OSSEOUS AND CARTILAGINOUS STRUCTURES: No bone marrow abnormalities identified. Diffuse thinning of the cartilage is noted.

NERVES: The ulnar nerve is normal in signal and caliber.

MISCELLANEOUS: No joint effusion or loose bodies are identified.

IMPRESSION:

1. An acute tear of the biceps tendon at its insertion on the radius is associated with approximately 5.5 cm of retraction of the proximal tendon.

2. The common extensor tendon is frayed and irregular and may be consistent with prior injury.

Good radiology report-

- Identify acute injuries
- Downplay chronic injuries
- Summary or Impression highlights important findings

Upper Extremities Imaging

- Give pertinent history when ordering imaging
  - Radiology can help answer them
- Plain radiography – start with this first
- Acute injuries – can order further imaging or quick referral
- Chronic injuries – can order further imaging and interpret results
- Post op injuries - referral

Thank You

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