Lower Extremity Imaging – What to Order and How to Interpret the Report

C. Benjamin Ma, MD
Professor in Residence
Shoulder and Sports Medicine
University of California, San Francisco
Department of Orthopaedic Surgery

Objectives: Lower Extremity Imaging

- Different Imaging Modalities
- Imaging orders that make you look “awesome”
- 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**

- Write down what you are concerned about
  - Xrays of ankle with concern of fibular fracture
  - MRI of knee with recurrent instability
- Radiologists can help getting the right studies for you
- They can also suggest better studies

**Plain radiographs**

- Image obtained by projecting of 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
- Orthogonal views (projection!)
  - AP/lateral of the joint
Lower extremity imaging

- Lower extremity are weight bearing joints.
- Joint alignment can be very different with weight bearing
- Can get weight bearing x-rays to look at joint space and alignment

What to order? Make you look good!

- Knee
  - AP and Lateral knee
  - Weight bearing AP
  - Patellofemoral views

What to order?

- Hip
  - AP/ frog leg lateral
  - AP pelvis

What to order?

- Ankle
  - AP/lateral ankle
  - Mortise view of ankle
What to order?

- Foot
  - AP/lateral/oblique foot
  - Weight bearing lateral?

What to look for?

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

Interpretation

- Displaced fractures – always need attention
- Non displaced fracture – can immobilize
- Stress fracture/ cannot rule out….
  - Need secondary evaluation
  - Further imaging
  - Closer followup

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
  - Knee ganglions
  - Foot ganglions
- Diagnose tendon tears
  - Foot peroneal tendon injuries
  - Achilles tendon ruptures
Ultrasound

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

CT scan

- Tomographic evaluation of the region of interest
- Good for 3D bony anatomy
  - Degenerative joint anatomy
- Complex reconstruction
- Post-traumatic injuries
  - Ankle malunion

CT scan

- Advantages
  - Tomographic evaluation
  - No magnification
  - Give 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
  - Contraindicated for pregnant patients

Nuclear imaging

- Uses radioisotope-labelled biological 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 up
  - Low sensitivity for lytic problems
    - Multiple myeloma
MRI
- Current gold standard for soft tissue injuries
  - Ligament tears
  - Labral tears
  - Cartilage injuries
  - Meniscus tears

MRI with contrast - Gadolinium
- Intra-articular contrast
  - Distends the joint
  - Enable evaluation of ligament and labrum
  - Hip labral tears
  - Meniscus repairs

MRI - Gadolinum
- Intravenous contrast
- Evaluate vascularity
  - Tumor
  - Post-surgical changes, such as scar tissue
  - Concern with kidney insufficiency and complications
- Usually ordered by specialists

MRI
- Helpful to evaluate ligament integrity
- Quality of cartilage
  - fraying
  - arthritis
- Labrum and meniscus injuries
**MRI**

- Helpful to evaluate ligament integrity
- Quality of cartilage
  - fraying
  - arthritis
- Labrum and meniscus injuries

---

**MRI**

- Helpful to evaluate ligament integrity
- Quality of cartilage
  - fraying
  - arthritis
- Labrum and meniscus injuries

---

**Radiology Reports – love adjectives!**

- Fraying vs Partial tear vs Full thickness tear (Mucoid Degeneration)
- Cartilage inhomogeneity vs fissure vs flap vs unstable flap vs full thickness cartilage loss
- Tendon degeneration vs tendinosus vs tear

Clinical Correlation Recommended

---

**How do you interpret the report?**

- What are the big words?
  - Fractures
  - Tears / disruption – full thickness
  - Displaced….
  - Lesion possible neoplasm
  - Advanced….arthritis
**MENISCUS:** There is a complex tear of the body and posterior horn of the medial meniscus with large bucket-handle fragment displaced into the intercondylar notch paralleling the posterior cruciate ligament.

The native torn ACL is seen to be flipped anteriorly and back on itself within the anterior aspect of the intercondylar notch.

**IMPRESSION:**
1. Flipped appearance of the native torn ACL within the anterior aspect of the intercondylar notch is consistent with stump entrapment/cyclops lesion.
2. Large bucket-handle tear of the posterior horn and body of the medial meniscus.

**INDICATION:** Age: 17 years. Gender: Male. History: pain vs injury r/o fracture

**Bones and joints:** Osseous fragment over the superior pole of patella with marked thickening and irregularity of the quadriceps tendon.

**Soft tissues:** Large joint effusion with patellar soft tissue swelling.

**IMPRESSION:**
- Osseous fragment over the superior pole of the patella with marked thickening and irregularity of the quadriceps tendon with large joint effusion. Findings most compatible with superior pole patellar sleeve fracture.

**CLINICAL HISTORY:** r/o fx at left 5th MTP. Jammed foot 3 days ago.

**IMPRESSION:**
1. Mildly to moderately displaced extra-articular oblique fracture of the fifth metacarpal shaft. No evidence of dislocation.
2. Severe degenerative changes of the first MTP joint compatible with hallux rigidus.

**LABRUM:** Degenerative tearing of the anterior and superior labrum. Degenerative ossification is also seen in the anterior labrum (image 17, series 4).

**LIGAMENTS:** The ligamentum teres and transverse acetabular ligament are intact. Linear low signal intensity medial to the ligamentum teres may represent a thick acetabular plica.

**TENDONS:** The visualized rectus femoris, proximal hamstring, and iliopsoas tendons are intact. Edema around the gluteus tendon insertion, greater around the minimus than the medius, is compatible with mild peritendinitis.

**IMPRESSION:**
1. Degenerative tearing of the anterior and superior labrum.
2. Focal chondral loss along the superolateral and anterior femoral acetabular cartilage. Focal chondral loss along the posterior medial aspect acetabular cartilage.
3. Mild peritendinitis of the gluteus tendon insertion, greater around the minimus than the medius.

**65 yo with mild hip arthritis and tendinitis**

Age appropriate changes
Asymptomatic Lesions

- High prevalence of meniscus tears in older individuals
- Especially with osteoarthritis (91%)
- May not be symptomatic
- “complex” tear is an appearance, may not be symptomatic

Lower Extremities Imaging

- Write down what your question is
  - Radiology can help answer them
- Plain radiography – first start
- Acute injuries – can order further imaging or quick referral
- Chronic injuries – can order further imaging and interpret results
- Post op injuries - referral

Lower Extremities Imaging

- Orthogonal views of xrays
- Advanced imaging can be helpful but careful with interpretation
- Not all “tears” are bad

What to order – lower extremities

- Chicken Feet
- Pig’s Knuckle
- Osso Bucco
Thank you

- C. Benjamin Ma, M.D.
  Professor in Residence
  UCSF Department of Orthopaedic Surgery
  Sports Medicine and Shoulder
  (415) 353-7566
  maben@orthosurg.ucsf.edu