APPROPRIATE IMAGING OF THE LOWER EXTREMITY
OBJECTIVES

I. Overview of appropriate imaging
   - Cost
   - ACR

II. Plain x-ray views

III. Advance imaging
   - MRI
   - CT
   - Bone Scan
OBJECTIVES

- IV. Hip/pelvis
  - Acute
  - Chronic
- V. Knee
  - Acute
  - Chronic
- VI. Ankle/foot
  - Acute
  - Chronic
OVERVIEW

- Cost
- ACR
- Imaging modalities
## Imaging Modalities

<table>
<thead>
<tr>
<th>MODALITY</th>
<th>CHARGE (APPROXIMATE)</th>
<th>TIME (MINUTES)</th>
<th>IDEAL USES</th>
<th>CONTRA-INDICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT SCAN</td>
<td>$845</td>
<td>15-30</td>
<td>Bony anatomy, clarify fx, tumor matrix</td>
<td>Pregnancy</td>
</tr>
<tr>
<td>MRI</td>
<td>$1500</td>
<td>60</td>
<td>Soft tissue, bone edema, fx lines, fluid, bursa, tumor matrix</td>
<td>Ferromagnetic materials, pacemaker, defib, metallic hardware</td>
</tr>
<tr>
<td>BONE SCAN</td>
<td>$700</td>
<td>INJECTION + IMAGING 90 MINUTES</td>
<td>Increased bone turnover, stress fx, fractures, tumor</td>
<td>Pregnancy, radioactive dye allergy</td>
</tr>
<tr>
<td>X-RAY</td>
<td>$35-250</td>
<td>5-15</td>
<td>Bony anatomy, alignment, fx, periosteal rxns, callus, non-union</td>
<td>Pregnancy</td>
</tr>
</tbody>
</table>
ACR (American College Radiology)

- Musculoskeletal imaging committee
  - 8 radiologists
  - 2 orthopedic surgeons
  - Rating between 1 and 9
  - 1 least appropriate
  - 9 most appropriate
OBJECTIVES

IV. Hip/pelvis
   - Acute
   - Chronic

V. Knee
   - Acute
   - Chronic

VI. Ankle/foot
   - Acute
   - Chronic
TIPS

- TREAT THE PATIENT, NOT IMAGING
- TREAT THE PATHOLOGY NOT PAIN
- EVALUATE FUNCTION AND CORRELATE WITH IMAGING IF NECESSARY
- Imaging Modality
- Working Diagnosis
- Specificity of Location
- Eg. MRI left knee
  - Evaluate degenerative tear posterior horn medial meniscus
CASE # 1  -Acute Hip Pain

65 y/o female slips and falls at home. She is unable to bear much weight, and she c/o some severe right groin pain.
CASE # 1-Acute Hip Pain

- **SUSPECT:**
  - Femur fracture (shaft, neck)
  - Pelvic fracture

- **Plain PELVIS AP**
  - (NOT SINGLE HIP)
  - ACR (9)
  - Frog leg view (externally rotated) view (if AP negative)
CASE #2-
Chronic Hip Pain

- 50 y/o female c/o right groin pain x 6 months. No prior traumatic injury. Pain with walking and some painful loss of hip range of motion.
CASE #2
Chronic Hip Pain

- **Suspect:**
  - Osteoarthritis of the hip
  - Transient osteoporosis of the hip
  - Avascular necrosis of the hip
  - Femoral neck stress fracture
  - Pelvic stress fracture
  - Osteitis Pubis
  - Tumor

- **Pelvis (AP, frog leg):**
  - **ACR: 9**
  - **Negative x-ray, suspect:**
    - Trochanteric bursits
    - SI joint
    - Piriformis syndrome
    - ITB
    - Adductor
    - Soft Tissue injuries
CASE #2
Chronic Hip Pain

Consider further imaging:
- Arthritis on plain x-ray?
  - MRI not recommended
  - ACR: 2
- No arthritis
  - MRI (ACR: 9)
  - Bone Scan (no ACR rating)
  - Suspect:
    - AVN hip
    - Transient osteoporosis
    - Pelvic stress fx
    - Femoral neck stress fx
    - Labal tear (MRI-arthrogram)
MRI PELVIS
CASE #3 - Acute Knee Pain

- 35 y/o male c/o knee pain after ski injury. He is unable to flex his knee 90 degrees.
OTTAWA CRITERIA - KNEE

- 1. Age 55 or older
- 2. Isolated tenderness of the patella
- 3. Tenderness of the head of the fibula
- 4. Inability to flex at 90 degrees
- 5. Inability to bear weight
- * Joint effusion within 24 hours
CASE #3-Acute Knee Pain

- Walk with no limp
- Twisting injury and no effusion
- Suspect:
  - Patellar instability
  - Collateral ligament injury
  - Synovial plica
  - Fat Pad impingement
  - Stable knee injuries
  - No x-rays
  - ACR: 2

"How bad is it doctor? Should I start dating?"
CASE #3-Acute Knee Pain

- Meet Ottawa Criteria:
- Suspect:
  - Patellar fracture
  - Fibular head fracture
  - Loose body (OCD injury)
  - Tibial plateau fracture
  - Femoral condyle fracture
  - Tibial spine avulsion
  - Lateral tibial plateau avulsion (Segund’s fracture)
  - 2-v Knee, wt-bearing AP or PA, lateral + Merchant’s if anterior knee pain
  - ACR: 9
CASE #3-Acute Knee Pain

- NO ACR recommendations for acute twisting knee injury with instability, recurrent swelling or mechanical symptoms

- SUSPECT:
  - Cruciate ligament injury
  - Meniscal injury
  - OCD injury/loose body

- MRI (no ACR rating)
Torn Anterior Cruciate Ligament
ACL-Meniscus

- **LOCKED BUCKET HANDLE-ACL**
  - *Test Passive terminal extension*
  - 2-stage arthroscopy
    - Repair meniscus
    - Delayed ACL reconstruction
SPECIFICITY OF CONDITION

- NOT ALL CRUCIATE LIGAMENT TEARS NEED SURGERY
  - ACL IN MIDDLE AGE, PARTICULARLY WITH ARTHRITIS MAY NOT NEED IT
  - PCL TEARS AND SOME MENISCAL TEARS CAN BE TREATED CONSERVATIVELY
  - MRI SHOULD BE PREOPERATIVE TOOL.
CASE #4-Chronic/Non-traumatic knee pain

- 53 y/o male with medial compartment pain and mild swelling x 2 months. Stable knee exam, ttp of medial compartment.
CASE #4-Chronic/Non-traumatic knee pain

- **Suspect:**
  - Arthritis (medial, lateral, patellofemoral)
  - Patellar malalignment
  - AVN femoral condye
  - Loose bodies
  - Osteochondral lesions
  - Stress fractures
  - Tumor
  - Pellegrini-Stieda

- 2-v Knee, **wtbearing** PA or AP, lateral + Merchant’s if anterior knee pain

- ACR: 9
CASE # 4-Chronic/Non-traumatic knee pain

Consider further imaging?

- MRI (ACR: 1) following conditions:
  - Significant osteoarthritis
  - Inflammatory arthritis
  - Stress fracture on x-ray
  - AVN on plain x-ray
  - RSD

Figure 4. An MRI scan of the knee
CASE # 4-Chronic/Non-traumatic knee pain

Consider further imaging?

- SUSPECT:
  - Degenerative meniscal injury (symptomatic)
  - Chronic cruciate ligament injury
  - AVN femoral condyle
  - Osteochondral injuries
  - Tumors

- MRI (ACR: 9)

- Note:
  - AVN may develop >6 wks after symptoms.
  - Radial Meniscal Tears may heal
MRI - OCD LESIONS
CASE # 4-Chronic/Non-traumatic knee pain

- Consider further imaging?

  - SUSPECT:
    - Patellofemoral syndrome
    - Osteoarthritis
    - Tendonitis (Hamstring/Patellar)
    - ITB syndrome
    - Bursitis (Pre-Patellar/ITB)
    - Synovial Plica
    - Synovitis
    - Meniscal Tear

  - NO MRI
ANKLE VS. FOOT

- **ANKLE**
  - Tibiotalar joint

- **FOOT**
  - Hindfoot
  - Midfoot
  - Forefoot
CASE # 5-Acute Ankle Injury

- 25 y/o male inverts right lateral ankle. He has lateral swelling and unable to bear weight immediately.
Case #5-Acute Ankle Injury

- Ottawa Criteria:
  - Non-weightbearing after injury or in emergency dept/clinic
  - Tenderness over malleoli (posterior $\frac{1}{2}$ lateral malleolus), talus, calcaneus
  - Inability to ambulate 4 steps
Case #5 - Acute Ankle Injury

- **Suspect:**
  - Fibular fx/lateral malleoli
  - Distal tibia fx/medial malleolus
  - Talus fx (lateral process/dome, neck)
  - Calcaneus (anterior process)
  - Syndesmotic injury

- **Ankle 3-v (AP, lateral, mortise)**
  - ACR: 9

- **Continued sx, repeat 3v**
  - Suspect:
    - Missed/occult fx
    - Talar dome OCD
CASE #6-CHRONIC ANKLE PAIN

- 33 y/o male with recurrent ankle injuries and anterolateral ankle pain with mild swelling x 6 months.
CASE #6-CHRONIC ANKLE PAIN

- **SUSPECT:**
  - Talar dome OCD
  - Loose bodies
  - Ankle/subtalar arthritis
  - Tumor

- **Ankle 3-v**
  - ACR: 9
CASE #6-CHRONIC ANKLE PAIN

- Improved with rehab

- SUSPECT:
  - Deconditioned ankle
  - Chronic ankle ligamentous instability
  - Tendinopathy
  - Other soft tissue injuries

- No further imaging
CASE #6-CHRONIC ANKLE PAIN

- Continued sx and negative x-rays
- **SUSPECT:**
  - Posterior tibialis tendonitis/tear
  - Peroneal tendonitis/tear
  - Talar Dome OCD
  - Tarsal Coalition
  - Stress fx (distal fibula/tibia)
- **MRI (ACR: 9)**
- **SUSPECT:**
  - Talar Dome OCD
  - Tarsal Coalition
- **CT SCAN (ACR: 2)**
MRI ANKLE-TALAR DOME OCD
CASE#7-Acute foot injury

- 37 y/o female twists foot, has swelling on dorsum of foot.
CASE#7-Acute foot injury

- MIDFOOT/FOREFOOT

- SUSPECT:
  - Metatarsal fx
  - Jones fx
  - Phalynx fx
  - LisFranc injury
  - Tarsal coalition
  - Accessory navicular
  - Anterior process of calcaneus fx
  - Lateral process of talus fx
  - Turf toe (MTP sprain)

- Foot 3-v
  (AP/ lat/ oblique)
  - ACR: 9
CASE#7-Acute foot injury

- NEGATIVE X-RAY
- Consider further imaging?
  - Uncommon injuries:
- SUSPECT:
  - Posterior tibialis tendon tear
  - Peroneal tendon tear
  - LisFranc injury (should have had weightbearing feet with comparison views)
- MRI foot (ACR: 9)
ACUTE-HINDFOOT INJURY

- Direct fall on hindfoot
- SUSPECT
  - Calcaneus fx
- Calcaneus 2-v
  - Lateral, Harris-Beath
  - ACR: 9
CASE #8-CHRONIC FOOT PAIN

- 54 y/o female with lateral mid-foot pain x 6 months with mild swelling and limp.
CASE #8-CHRONIC FOOT PAIN

- MIDFOOT/FOREFOOT
- SUSPECT:
  - Metatarsal stress fx
  - Tarsal navicular stress fx
  - Cuboid stress fx
  - Midfoot arthritis
  - Accessory navicular
  - Os cuboidis
  - Freiberg’s infraction
  - Sesamoiditis (sesamoid/axial view helpful)
  - Hallux valgus
  - Tumor
  - Jones stress fx

- Foot 3-v
  - ACR: 9
CASE #8-CHRONIC FOOT PAIN

- MIDFOOT/FOREFOOT

- SUSPECT:
  - Tarsal navicular stress fx

- CT scan foot
  - ACR: 9

- SUSPECT:
  - Peroneal tendonitis/ tear
  - Posterior tibialis tendonitis/ tear
  - Stress fractures (talus, metatarsal, navicular)
  - Painful accessory bones

- MRI foot
  - ACR: 9
CASE #8-CHRONIC FOOT PAIN

- **MIDFOOT/FOREFOOT**
- **SUSPECT STRESS FX:**
  - Tarsal navicular
  - Metatarsal
  - Talus
  - Cuboid
  - Calcaneus (hindfoot)

**Bone scan**
- ACR: 6
- + scan for Navicular or Talus stress fx
- CT scan or MRI/refer
- All others and negative study follow clinically
CASE #8-CHRONIC FOOT PAIN

SUSPECT:
- Plantar fascitis
- Neuroma
- Metarsalgia
- Painful pes planus
- Achilles tendonitis
- Fat pad insufficiency

No further imaging necessary
CASE#9-CHRONIC HINDFOOT PAIN

- **SUSPECT:**
  - Calcaneus stress fx
  - Talar neck stress fx
  - Subtalar arthritis
  - Painful os trigonum
  - Haglund’s deformity
  - Tarsal coalition (Calcaneonavicular coalition seen on foot oblique), Obtain foot 3-v as well

- **Calcaneus 2-v**
  - Lateral, Harris-Beath
  - ACR: 9
SUMMARY

- Classify musculoskeletal conditions as acute or chronic/non-traumatic
- Have specificity of location of symptoms/exam findings
- Have linear thought process for differential diagnoses and subsequent imaging
- Conservative treatment and imaging is often warranted
DON'T ADD STRESS TO YOUR PATIENTS!

"My doctor told me to avoid any unnecessary stress, so I didn't open his bill."