What Plain Views and When to Order Advanced Imaging

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ACSM Team Physician™ Course – Part II

Essentials of Sports Medicine: From Sideline to the Clinic

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Learning Objectives:

1. Know the images and position of the patient to order for certain diagnoses
2. Understand when to order advanced images after plain X-Rays

I have nothing to disclose.
WORKUP
Algorithm for Evaluation and Treatment of Suspected High-Risk Stress Fractures

(Reprinted with permission from Boden BP, Osbahr DC. High-risk stress fractures: Evaluation and treatment. *J Am Acad Ortho Surg* 2000; 8(6):344-353, Fig. 1, p. 347.)
Low Risk Compression Side
Radiographs

- Helpful identifying morphological variants predisposing to intraarticular pathology
  - Dysplasia (reduced CE angle)
**IMAGING**

- **Plain radiographs**
  - Radiographs most important investigative tool
  - Poorly indicative of problems amenable to arthroscopic intervention
    - McCarthy & Busconi, Orthop 1995
- **Insensitive indicator of early OA**
  - Santori & Villar, Orthop 1999
Radiographs

- AP pelvis including both hips
  - Properly centered to assess radiographic indices
  - Allows comparison of contralateral hip for subtle variations
  - Allows assessment of surrounding areas (ilium, ischium, pubis, sacrum & SI joints)
Radiographs

- Lateral view of affected hip
  - Frog lateral (lateral of proximal femur; not a true lateral of joint)
- Consistent, reproducible study
- Cross table, False profile, Dunn, etc. for specific circumstances
IMAGING: Femoroacetabular impingement

- Helpful identifying morphological variants predisposing to Intra-articular pathology:
  - Pincer type (acetabular retroversion)
    - Cross-over sign
    - Posterior wall sign
    - Arthroscopic parameters more sensitive indicator
  - Cam-type (proximal femur)
    - SCEF; “Pistol grip” deformity (premature physeal closure)
    - CT reconstruction excellent (!) for three-dimensional architecture
Radiographs

• Helpful identifying morphological variants predisposing to intraarticular pathology
  • Femoroacetabular impingement
    • Cam-type (proximal femur)
      • CT reconstruction excellent(!) for three dimensional architecture
IMAGING: MRI SCAN

- Communicate with radiologist skilled in hips. Now better results if intra-articular gadolinium.
- Use of intra-articular injection is helpful
  - Lidocaine – if improves symptoms confirms intra-articular process
  - Gadolinium outlines labrum better
- Low resolution studies (small magnet; open scanner)
  - Unreliable except for obvious disease (i.e., AVN)
- High resolution MRI
  - 1.5 Tesla magnet; surface coil
  - Reliability improving
  - Still up to 42% false negative
  - Indirect evidence most reliable (effusion; paralabral cyst; subchondral cyst)
- MRI helpful for:
  - Labrum tear
  - Articular cartilage defects
  - Ligamentum teres tears
  - Impingement
  - Capsule/ileofemoral injury
1.5 Tesla

Courtesy Martin L. Schwartz, MD
0.35 Tesla Open

Courtesy Martin L. Schwartz, MD
1.0 Tesla Extremity

Courtesy Martin L. Schwartz, MD
Low Resolution Studies

- (small magnet; open scanner)
  - Unreliable except for obvious disease (i.e., AVN)
High Resolution MRI

- 1.5 Tesla magnet; surface coil
- Reliability improving
- Still up to 42% false negative
- Indirect evidence most reliable (effusion; paralabral cyst; subchondral cyst)
MRA
• Greater sensitivity (8% false negative)
• 20% false positive (double that of MRI)
• Always inject bupivicaine with contrast!
  • Intraarticular injection
  90% reliable
45 Degree Flexed Weight-Bearing PA View is most sensitive for detecting joint space loss


16 YO WM Football Athlete
Struck from Lateral Side of Knee
Complete radial tear of the interval horn/body junction), with a high-grade radial tear of the posterior horn/root junction
Bone Bruise

Does That Predict Development of OA?
Bone Bruise Patterns

- Acute patellar dislocation
- Medial patella anterolateral femoral condyle
- No OA from bone bruise, but from articular cartilage injury and mal-tracking
Bone Bruise Patterns

- In soccer, medial tibial plateau bone bruise no long term risk of OA
- In degenerative posterior horn root avulsions, medial tibial bone bruise often seen

? Long-term follow-up for bone bruises needed to determine significance for development of OA
What is the significance of Bone Bruises?

Unknown...

- Long term Bone Bruise ≠ OA
- In ACL injuries noncontact compartments:
  - Lateral / acute
  - Medial / chronic OA
- Classification systems for bone bruises need further development
History & PE

- 55 YO Female
- Difficulty walking due to left knee out of alignment
- Fell 10 years ago and was told she had meniscal tears
- PE: Height 5’ 5½”, weight 303: BMI 43
- Bilateral Knees:
  - Diffuse crepitus and pain
  - Mild effusion
  - No calf tenderness
Right Knee

What test would you do next?
MRI

Are more tests needed?
MRI Scan in the Arthritic Knee After 50 years

- Not Helpful for Articular Cartilage
- Meniscal Signal Will Usually Be Abnormal and come to the tibial surface.
MRI Scan in the Arthritic Knee After 50 years

• Is the root of the Medial Meniscus Avulsed?
• What about my Baker’s Cyst?
• Think tree - MRI Scan
  • In a Big Forest – Arthritis
    —The Plain Xrays show us the reason for stiffness & pain: Arthritis
IMAGING THE ARTHRITIC KNEE

- Use goniometer to assure comparable Xrays year to year and for outcome studies.

- Let the Orthopaedist Order the MRI Scan in the Arthritic Knee Patient.
  - May want DESS or special articular cartilage sequences.
  - In most cases MRI scans in patients over age 50 would not change treatment plan.
  - I don’t need an MRI scan to know what to do arthroscopically! I was scoping knees prior to MRI scans!
Fig. 19-25. Lateral (left) and anteroposterior (right) drawings of the foot indicating the location of the commonly found accessory bones (circles with numbers) and forefoot sesamoids (shaded circles). (1) Os tibiale externum, (2) processus uncatus, (3) os intercuneiforme, (4) pars peronea metatarsalia 1, (5) cuboides secundarium, (6) os peroneum, (7) os vesalianum, (8) os intermetatarsaeum, (9) os supratalare, (10) talus accesso- ries, (11) os sustentaculum, (12) os trigonum, (13) calcaneus secundarium, (14) os subcalcis, (15) os supranaviculare, (16) os talotibiale. (Keats, T. E., An Atlas of Normal Roentgen Variants That May Simulate Disease, 2nd ed., p. 371. Chicago, Year Book Medical Publishers, 1979.)
# Secondary Center Ossifications

- **Apophysis** – present 22%
  - Appears > 8 years
  - Fusion: 12 years - females
  - 15 years - males

- **Os peroneum**
  - In tendon at cuboid level

- **Os versalianum** – present 15%
  - Insertion peroneus brevis
  - Usually bilateral – present in 0.1%
19 YO basketball player Os vesalianum bilateral feet.
Os peroneum
PAINFUL OS PERONEUM

Courtesy UK Radiology
PAINFUL OS PERONEUM

Courtesy UK Radiology
Marathon Runner Complains of Heel Pain Around Achilles Tendon 2 Weeks Post Race
Occult Calcaneal Fracture

Courtesy Martin L. Schwartz, MD
Basketball Player with Proximal Foot Pain

Courtesy Martin L. Schwartz, MD
Tarsal Navicular Stress Fracture

Courtesy Martin L. Schwartz, MD
NAVICULAR STRESS REACTION
ACHILLES TEAR

Courtesy UK Radiology
ACHILLES TEAR

Courtesy UK Radiology
AP Internal View
Outlet View
Imaging

- Special Studies
  - MRI scan
    - With or without gadolinium
  - CT scan
  - Ultrasound
Ultrasonography

- In office
- Accurate
- Low cost

Ultrasound showing symptomatic progression of previously asymptomatic rotator cuff tear.

Yamaguchi K et. al., “Natural history of asymptomatic rotator cuff tears: A longitudinal analysis of asymptomatic tears detected sonographically,”
When Should an MRI Exam Be Obtained?

- Recent Trauma
- Difficult Physical Exam
- Physical Exam that Does not Match Clinical Symptoms
- Normal Radiographs with Significant Symptoms
- Pre-Operative Planning
- Recent MRI that was Technically Suboptimal

Courtesy Martin L. Schwartz, MD
How Should The MRI Scan Be Performed

• Best Possible Equipment
• Dedicated Coils for the Body Part
• Contrast When Necessary
• Correct Sequences to Define Appropriate Anatomy
• Shortest Exam to Achieve Results and Keep Patient Comfortable

Courtesy Martin L. Schwartz, MD
Contrast Administration

- Intraarticular Contrast Gives Superior Soft Tissue Contrast and Significantly Enhances Diagnostic Capability
- Intravenous Contrast Useful for Post Operative Menisci and Tumors

Courtesy Martin L. Schwartz, MD
Intraarticular Contrast Injection

- Use Sterile Technique and Fluoroscopic Guidance
- Mix Iodinated Contrast with Dilute Gadolinium Solution to Avoid Air Bubbles
- Use Enough Volume to Distend Joint
- Perform Injection Quickly and as Painlessly as Possible

Courtesy Martin L. Schwartz, MD
MRI Scan with Intraarticular Gadolinium

<table>
<thead>
<tr>
<th>Varying position</th>
<th>Arm at Side IR + ER</th>
<th>Thumb down and up</th>
<th>Hyper Abduction</th>
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Abducted externally rotated position to diagnose peel back--ABER view

- Advantages may not need intra-articular gadolinium to diagnose SLAP tear
- Must have method so patient will be comfortable and not move
- Recent studies show ABER view in patients with unstable SLAP lesions had posterior humeral head translation in ABER compared to neutral abduction of greater than 3 mm
- Look for humeral head position or position of the labrum and glenoid posterior-superior
You Look for What You Know and You Find What You Look For
The End

Thank You!

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