Easily Overlooked Musculoskeletal Findings:
Plain Film with MRI Correlation

Christine B. Chung, M.D.
Professor of Radiology
Musculoskeletal Division
UCSD and VAHCS

Fundamentals of MR Imaging
MR Imaging versus Plain Film

• Contrast versus resolution
• Multiplanar imaging capability

Plain Film Versus MRI
Joint Effusion Characterization

• Hemarthrosis
  - Serum above
  - Blood below

Plain Film Versus MRI
Joint Effusion Characterization
Role of MR Imaging in RA
Evaluation of the Synovium

- Presentation with STS, no erosions

What is the Significance of Synovitis as Diagnosed by MRI?

- Objective:
  - To evaluate the synovial membrane volume determined by MRI as a marker of disease activity and predictor of joint destruction in RA
- Methods:
  - Prospective study (n=26) RA patients (active disease with indication for instituting or changing DMARD therapy)
  - PF (presentation, 1 year)
  - MRI (presentation, 3, 6, and 12 months)
- Results/Conclusions:
  - MRI determined synovial volumes are closely related to rate of progression of joint disease
  - Quantitative MRI assessment may prove valuable as a marker of joint disease activity and as a predictor of progressive joint destruction in RA

New Radiographic Bone Erosions in the Wrists of Patients With Rheumatoid Arthritis Are Detectable With Magnetic Resonance Imaging a Median of Two Years Earlier

How is Erosion Defined by MRI?

  - Focal loss of normal low signal intensity from cortex on T1-weighted images, increased signal on T2-weighted images, and enhancement after contrast
- McQueen, et al., Ann Rheum Dis 2001; 60: 859-868
  - Focal areas of loss of low signal intensity cortex
  - Sharply defined margins seen on T1- and T2-weighted images
  - Low on T1-, high on T2-, enhanced after contrast
  - Seen in at least 2 planes
  - Cortical break in at least 1 plane (distinguishing it from a cyst)
  - Cortical break seen in at least 1 plane
  - MRI bone erosion required to be visible in 2 planes

MR Imaging Detection of Erosion in RA

- Ostergaard, et al.,
  - Objective
    - Temporal relationship between development of joint erosion by MR versus PF
  - Methods
    - MRI and PF each year for 5 years (n=10) in pts with RA (1.5 yrs median)
  - Results/Conclusions
    - 21/27 erosions detected over 1-5 years earlier by MRI (median 2 years)
    - Increased risk progression of erosions in patients with baseline MRI erosions

MRI of Synovial Inflammatory Disease
Erosion Detection

New Radiographic Bone Erosions in the Wrists of Patients With Rheumatoid Arthritis Are Detectable With Magnetic Resonance Imaging a Median of Two Years Earlier

Mikkel Ostergaard, Michael Hansen, Michael Stoltersen, Peter Odean, Mette Kjeldsen, Kaj Erik Jensen, and EB Lorenzen
MRI of Synovial Inflammatory Disease
Erosion Detection

MRI of Synovial Inflammatory Disease
Erosion Detection

MRI of Synovial Inflammatory Disease
Erosion Detection

MRI of Synovial Inflammatory Disease
Erosion Detection
<table>
<thead>
<tr>
<th>Condition</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glenohumeral Joint OA</td>
<td><img src="image1.png" alt="Glenohumeral Joint OA" /></td>
</tr>
<tr>
<td>Cuff Arthropathy</td>
<td><img src="image2.png" alt="Cuff Arthropathy" /></td>
</tr>
<tr>
<td>Acetabularization of the Acromion</td>
<td><img src="image3.png" alt="Acetabularization of the Acromion" /></td>
</tr>
<tr>
<td>Femoralization of the Humerus</td>
<td><img src="image4.png" alt="Femoralization of the Humerus" /></td>
</tr>
<tr>
<td>Rotator Cuff Lesion: Geyser Sign</td>
<td><img src="image5.png" alt="Rotator Cuff Lesion: Geyser Sign" /></td>
</tr>
<tr>
<td>Reverse Shoulder Arthroplasty</td>
<td><img src="image6.png" alt="Reverse Shoulder Arthroplasty" /></td>
</tr>
</tbody>
</table>
Pre-op True AP View
Assess Axillary Border of Scapula (Pillar)

- Axillary border: squared off vs. sloped (nl).
- Typically want metaglene (base plate) as low as possible on the glenoid to reduce impingement between the humeral component and scapula (‘notching’).
  - Dependent on type of prosthesis and directions of baseplate screws.
- Disadvantage of squared-off border: if position the base plate more centrally, may increase risk of inferior-most screw protruding outside the scapula.
- Advantage of squared-off border: less chance of scapular erosion by medial aspect of humeral component, assuming no issues with screw fixation.

Roberts C C et al. Radiographics 2007;27:223-235

Pre-op CT

- Assess glenoid bone stock
- Ideally, want 2cm depth (arrow) to attach metaglene anchoring screws
- If insufficient glenoid, bone grafting may be performed

Roberts C C et al. Radiographics 2007;27:223-235

Preop MRI

- Determine if intact teres minor tendon and muscle
- Helps with postop external rotation

Hydroxyapatite Crystal Deposition

Bursal Migration

Hydroxyapatite Crystal Deposition

Bursal Migration
Teres Minor Deposition
Bursal Migration and Bone Marrow Edema

Calcific Bursitis

Extra- and Intra-osseous

84 yo woman with bilateral hip pain
Fosamax Induced Stress Fx

- Link between prolonged bisphosphonate therapy and atypical femur fractures
- Bisphosphonate may suppress bone turnover
- Results in skeletal microdamage accumulation

Imaging Findings

- Fractures located .5 – 18.3 cm below lesser trochanter
  - 79% < or = 5 cm below trochanter
- Medial beak (85%) and varus angulation
- "Skirt" of focal buttressing at lateral cortex
- Increased propensity for bilateral involvement (12/22)
- All women aged 50-81 years
- On alendronate therapy minimum 4 years up to 14 years

Chan, et al., AJR; 194: 1581-1586

Imaging Findings

- Fractures located .5 – 18.3 cm below lesser trochanter
  - 79% < or = 5 cm below trochanter
- Medial beak (85%) and varus angulation
- "Skirt" of focal buttressing at lateral cortex
- Increased propensity for bilateral involvement (12/22)
- All women aged 50-81 years
- On alendronate therapy minimum 4 years up to 14 years

Chan, et al., AJR; 194: 1581-1586

MR Imaging Findings

- Fractures located .5 – 18.3 cm below lesser trochanter
  - 79% < or = 5 cm below trochanter
- Medial beak (85%) and varus angulation
- "Skirt" of focal buttressing at lateral cortex
- Increased propensity for bilateral involvement (12/22)
- All women aged 50-81 years
- On alendronate therapy minimum 4 years up to 14 years

Chan, et al., AJR; 194: 1581-1586
Take Home Points

- High association of bilateral involvement with limited symptoms indicate screening of both hips
- Subset of fractures occur well below the lesser trochanter – be sure entire femur is evaluated
- MR findings can be subtle and focused at endosteum

Case Study
Nonspecific Dull Aching Pain

Edge Loading

Axial T2

Metallosis in Metal on Metal Protheses

- Published March 3, 2010

MOM Pseudotumor
DePuy ASR System (Recalled)

- Type 4 hypersensitivity reaction
- Aseptic lymphocytic vasculitis-associated lesions (ALVAL)
- Pain/squeaking
- Elevated serum metal ion levels
- Elevated inflammatory markers
- Perivascular lymphocytic infiltrates without evidence of FB reaction
- Acellular necrotic tissue

Dull Aching S/P Metal on Metal THR
Tendon Avulsion
Metal on Metal Prosthesis
C3 Complication (Tendon Avulsion)

  - Rate of metallosis related revision 3.1% at 5 years
  - Risk factors
    - Female gender
    - Small femoral component
    - High abduction angle
    - Obesity

Take Home Points

- Be familiar with basic means to reduce metallic susceptibility artifacts
- Be aware of complications in orthopedic hardware
- In the setting of the MOM THR, evaluate for fluid collection and tissue necrosis

Spontaneous Osteonecrosis of the Knee (SONK)

First described by Ahlback 1968

Etiology
- Insufficiency fracture vs. necrosis
- “PSSR” (Presumptive Subarticular Stress Reaction)

Specific patient population
- Elderly females
- Sudden onset pain no h/o trauma

Specific imaging characteristics
- Subchondral lesion in MFC
- Low T1/ High T2 (+/- fx line)


Spontaneous Osteonecrosis of the Knee (SONK)


Spontaneous Osteonecrosis of the Knee (SONK)

SONK
Peripheral Pattern