80 yo F with hip and leg pain s/p fall

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Patient Presentation

- **HPI**: 80 y.o. F presents via EMS after being found down with left leg pain and deformity following a fall from standing height. Of note, patient recently saw a physician for left anterolateral thigh pain exacerbated by ambulation, and was diagnosed with stress fracture after an MRI.

- **PMH**: Osteoporosis, HTN, HLD, hypothyroidism

- **PSH**: R femur fracture s/p ORIF, carpal tunnel release

- **Medications**: Alendronate 70 mg weekly, Omeprazole 20 mg BID, HCTZ 12.5 mg QOD, Levothyroxine 137 mcg daily
Physical Exam

- **Neuro** - AOx3 normal speech, no focal deficits
- **Cardiovascular**: Normal rate, regular rhythm and intact distal pulses
- **Pulmonary/Chest**: Effort normal. Lungs clear to auscultation bilaterally
- **Abdominal**: Soft, non-tender, non-distended
- **Musculoskeletal** - Shortened left leg with tenderness at left hip and knee. Pain with left hip ROM. Sensation intact.
- **Skin** - No wounds or evidence of skin breakdown
Initial Labs

● CBC
  ○ WBC - 17.3 k/mcL
  ○ Platelets - 349 k/mcL
  ○ Hgb - 11.9 g/dL

● Electrolytes
  ○ Creatinine - 0.47 mg/dL
  ○ Calcium - 9.2 mg/dL
  ○ Phosphorus - 3.0 mg/dL

● INR - 1.2

● Total CK - 818 U/L
What Imaging Should We Order?
**ACR Appropriateness Criteria for Acute Pain s/p Fall**

**Variant 1:**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Appropriateness Category</th>
<th>Relative Radiation Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiography hip</td>
<td>Usually Appropriate</td>
<td></td>
</tr>
<tr>
<td>Radiography pelvis</td>
<td>Usually Appropriate</td>
<td></td>
</tr>
<tr>
<td><strong>Radiography pelvis and hips</strong></td>
<td>Usually Appropriate</td>
<td></td>
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<tr>
<td>CT pelvis and hips with IV contrast</td>
<td>Usually Not Appropriate</td>
<td></td>
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<tr>
<td>CT pelvis and hips without and with IV contrast</td>
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<td>MRI pelvis and affected hip without and with IV contrast</td>
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<tr>
<td>Tc-99m bone scan hips</td>
<td>Usually Not Appropriate</td>
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<tr>
<td>US hip</td>
<td>Usually Not Appropriate</td>
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</table>
Left Hip and Femur Radiographs - Findings (Unlabeled)
Hip MRI Prior to Admission - Findings (Unlabeled)
Radiograph Findings (Labeled)

Complete, transverse, non-comminuted, laterally displaced subtrochanteric fracture

Posterior displacement and angulation of distal fragment apparent on lateral view

Complete, transverse, non-comminuted, laterally displaced subtrochanteric fracture
Hip MRI Findings (Labeled)

Coronal T1-weighted FSE

Artifact from past internal fixation

Sagittal T1-weighted FSE

Hypointensity located on lateral aspect of femoral diaphysis

Linear, hypointense signal of the subtrochanteric humeral shaft
Final Dx:

Atypical femoral fracture secondary to bisphosphonate use

The patient underwent a left retrograde intramedullary fixation procedure.
Radiographs s/p ORIF with Left Intramedullary Nail
Atypical Femoral Fracture (AFF)

- **Definition:** Fracture predominantly seen in the proximal third of the shaft, just distal to the lesser trochanter, but can occur throughout the diaphysis down to the supracondylar region.
  - In comparison to 75% of femoral fractures which occur as result of high-impact trauma and are spiral in >50%, must be result of minimal to no trauma

- **Epidemiology:** Seen in women continuously treated with bisphosphonates with a 1 in 1000 prevalence compared to 0.02 in 1000 for untreated women

- **Pathogenesis:** Type of insufficiency fracture, occurring with normal stress on abnormal bone. Long-term suppression of bone remodeling by bisphosphonates is believed to cause deterioration of bone microarchitecture and reduction in the bone repair processes
**Table 3. ASBMR Task Force 2013 Revised Case Definition of AFFs**

<table>
<thead>
<tr>
<th>Description</th>
<th>Example</th>
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<tbody>
<tr>
<td>To satisfy the case definition of AFF, the fracture must be located along</td>
<td>The fracture line originates at the lateral cortex and is substantially transverse in its</td>
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<tr>
<td>the femoral diaphysis from just distal to the lesser trochanter to just</td>
<td>orientation, although it may become oblique as it progresses medially across the femur.</td>
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<tr>
<td>proximal to the supracondylar flare.</td>
<td>Complete fractures extend through both cortices and may be associated with a medial spike;</td>
</tr>
<tr>
<td>In addition, at least four of five Major Features must be present. None</td>
<td>incomplete fractures involve only the lateral cortex</td>
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<tr>
<td>of the Minor Features is required but have sometimes been associated with</td>
<td>The fracture is noncomminuted or minimally comminuted.</td>
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<tr>
<td>these fractures.</td>
<td>Localized periosteal or endosteal thickening of the lateral cortex is present at the fracture</td>
</tr>
<tr>
<td>Major features</td>
<td>site (&quot;beaking&quot; or &quot;flaring&quot;)</td>
</tr>
<tr>
<td>The fracture is associated with minimal or no trauma, as in a fall from</td>
<td>Major features</td>
</tr>
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<td>a standing height or less.</td>
<td>Generalized increase in cortical thickness of the femoral diaphyses</td>
</tr>
<tr>
<td>The fracture line originates at the lateral cortex and is substantially</td>
<td>Unilateral or bilateral prodromal symptoms such as dull or aching pain in the groin or thigh</td>
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<tr>
<td>transverse in its orientation, although it may become oblique as it</td>
<td>Bilateral incomplete or complete femoral diaphysis fractures</td>
</tr>
<tr>
<td>progresses medially across the femur.</td>
<td>Delayed fracture healing</td>
</tr>
<tr>
<td>Complete fractures extend through both cortices and may be associated</td>
<td>Changes are in bold.</td>
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<tr>
<td>with a medial spike; incomplete fractures involve only the lateral cortex</td>
<td>ASBMR = American Society for Bone and Mineral Research; AFF = atypical femur fracture.</td>
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<td>The fracture is noncomminuted or minimally comminuted.</td>
<td><em>Excludes</em> fractures of the femoral neck, intertrochanteric fractures with spiral subtrochanteric</td>
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<td>Localized periosteal or endosteal thickening of the lateral cortex is</td>
<td>extension, periprosthetic fractures, and pathological fractures associated with primary or</td>
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<td>present at the fracture site (&quot;beaking&quot; or &quot;flaring&quot;)</td>
<td>metastatic bone tumors and miscellaneous bone diseases (e.g., Paget’s disease, fibrous</td>
</tr>
<tr>
<td>Minor features</td>
<td>dysplasia).</td>
</tr>
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*Excludes* fractures of the femoral neck, intertrochanteric fractures with spiral subtrochanteric extension, periprosthetic fractures, and pathological fractures associated with primary or metastatic bone tumors and miscellaneous bone diseases (e.g., Paget’s disease, fibrous dysplasia).
Atypical Femoral Fracture

- **Radiographic/CT Features:**
  - 1) Fractures are transverse (or <30° oblique) w/ focal hypertrophy of the lateral cortex and lack of comminution
  - 2) Periosteal and endosteal callus formation
  - 3) Fracture has medial unicortical beak, w/ no features suggestive of underlying lytic process

- **MRI Features:**
  - Low signal intensity fracture line on all sequences traversing an area of bone marrow edema
    - Diffusely decreased signal intensity on T1W sequences
    - Increased signal intensity on T2W and STIR sequences
  - May see cortical thickening

- **Clinical Presentation:**
  - As with any fracture, pain and inflammation
  - The distinguishing clinical features includes their bilaterality and prodromal symptoms of deep thigh or groin pain
Atypical Femoral Fracture - Management

- Bisphosphonates should be discontinued.
  - Dietary calcium and vitamin D status should be assessed and adequate supplementation recommended.

- Incomplete fractures with cortical lucency accompanied by pain may undergo prophylactic fixation to prevent complete fracture

- Incomplete fractures without pain, or those with periosteal thickening but no cortical lucency may undergo conservative management with limited weight-bearing and avoidance of vigorous activity.
  - Activity restrictions should be continued until there is either no bone edema on MRI or no increased activity detected on bone scan.
References


