SPR 2015
The Good, the Bad and the Ugly

Diego Jaramillo, M.D., M.P.H.
Department of Radiology
Children’s Hospital of Philadelphia
University of Pennsylvania Pearlman School of Medicine
Variants, small abnormalities, and disease are closely related.
Little holes in the humeral head?
Developmental proximal humeral cyst

Posterior, adjacent to union between greater and lesser tuberosity
Cyst related to rotator cuff injury
(courtesy of Tal Laor, MD)

- Anterior, adjacent to footprint (insertion)
## Intertuberosity Cysts vs. Rotator Cuff Cyts

<table>
<thead>
<tr>
<th></th>
<th>Intertuberosity Cysts</th>
<th>Rotator Cuff Cysts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (yr)</strong></td>
<td>&lt;15</td>
<td>&gt;10</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>Posterior</td>
<td>Anterior</td>
</tr>
<tr>
<td><strong>Rotator Cuff Disease</strong></td>
<td>Not usually</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Little hole in the capitellum?
Osteochondral injury with loose body
Persistent pain after a fall

Acute Osteochondral Injuries

- Anterior capitellum
- Fragment usually detaches at o-c junction
- Only acute changes in the bone
13-year-old competitive tennis player
Osteochondritis Dissecans
Osteochondritis Dissecans

- Anterior to inferior capitellum
- Bone marrow edema
- Cystic changes
- Findings similar to those of OCD in the knee
8-year-old with elbow pain
Panner’s Disease

- Osteonecrosis of the capitellum
- First decade
- Repetitive trauma
“Pseudo Panner”:
Irregular ossification variant
Regarding elbow OCD and Panner’s disease, which of these statements is true:

1. Both affect the same age group
2. The trochlea is the structure most frequently affected by Panner’s disease
3. The capitellum is the structure most frequently affected by OCD
4. The articular cartilage is disrupted in Panner’s disease
Regarding elbow OCD and Panner’s disease, which of these statements is true:

1. Both affect the same age group
2. The trochlea is the structure most frequently affected by Panner’s disease
3. The capitellum is the structure most frequently affected by OCD
4. The articular cartilage is disrupted in Panner’s disease
# Panner’s vs. OCD vs. Osteochondral Fracture

<table>
<thead>
<tr>
<th></th>
<th>Panner’s Disease</th>
<th>OCD</th>
<th>Osteo-Chondral Fx</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (yr)</strong></td>
<td>&lt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
</tr>
<tr>
<td><strong>Throwing hx</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Variable (acute)</td>
</tr>
<tr>
<td><strong>Location (Capitellum)</strong></td>
<td>Diffuse</td>
<td>Anterior</td>
<td>Anterior</td>
</tr>
<tr>
<td><strong>Articular Cartilage</strong></td>
<td>Intact</td>
<td>Disrupted</td>
<td>Disrupted</td>
</tr>
<tr>
<td><strong>Marrow Edema</strong></td>
<td>Diffuse</td>
<td>Sub-chondral</td>
<td>Sub-chondral</td>
</tr>
<tr>
<td><strong>Loose Bodies</strong></td>
<td>No</td>
<td>Often, Osteochond.</td>
<td>Often, mostly chondral</td>
</tr>
<tr>
<td><strong>Cysts</strong></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Little holes in the proximal femoral epiphysis?
5-year-old boy with left hip pain and a small effusion
Femoral Notch

• Small notch along weigh-bearing region
• Intact overlying cartilage
• No predisposition for AVN
OCD-type (Ozonoff) Dysplasia

- Medial “punched out” lesion
- Marrow signal normal
- Small subchondral edema
- Slightly increased risk for AVN
Epiphyseal Dysplasia

- Legg Calve Perthes can be bilateral in sightly less than 10%
- Almost never synchronous
- Marrow signal normal in epiphyseal dysplasia
- Increased risk of AVN
• 5 year-old boy with limping and pain in the right hip for the last 4 weeks
Legg Calve Perthes Disease - DWI

- Increased ADC with AVN
- ADC remains elevated until disease heals
Regarding proximal femoral irregularities, which of the following is true:

1. Legg-Calve-Perthes is the only disease with abnormal ADC
2. The articular surface is disrupted with Ozonoff’s dysplasia
3. The proximal femoral notch is usually bilateral
4. Epiphyseal dysplasia has abnormal marrow signal intensity
Regarding proximal femoral irregularities, which of the following is true:

1. Legg-Calve-Perthes is the only disease with abnormal ADC
2. The articular surface is disrupted with Ozonoff’s dysplasia
3. The proximal femoral notch is usually bilateral
4. Epiphyseal dysplasia has abnormal marrow signal intensity
# Femoral Epiphyseal Irregularities

<table>
<thead>
<tr>
<th>Location</th>
<th>Femoral Notch</th>
<th>Epiph. Dysplasia, OCD type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Superior (weight-bearing)</td>
<td>Supero-medial</td>
</tr>
<tr>
<td>Side</td>
<td>Unilateral</td>
<td>Bilateral</td>
</tr>
<tr>
<td>Bone</td>
<td>Small excavation</td>
<td>Larger excavation</td>
</tr>
<tr>
<td>Articular cartilage</td>
<td>Intact</td>
<td>Intact</td>
</tr>
<tr>
<td>Marrow</td>
<td>Normal</td>
<td>Subchond. edema</td>
</tr>
<tr>
<td>ADC</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Enhancement</td>
<td>Normal</td>
<td>Normal</td>
</tr>
</tbody>
</table>
# Femoral Epiphyseal Irregularities

<table>
<thead>
<tr>
<th></th>
<th>Epiphyseal dysplasia (mult.)</th>
<th>Legg-Calve-Perthes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Diffuse</td>
<td>Diffuse</td>
</tr>
<tr>
<td><strong>Side</strong></td>
<td>Bilateral, synchronous</td>
<td>Unilateral (90%)</td>
</tr>
<tr>
<td><strong>Bone</strong></td>
<td>Fragmented</td>
<td>Fragmented</td>
</tr>
<tr>
<td><strong>Marrow Edema</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Subchondral fx.</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>ADC</strong></td>
<td>Normal</td>
<td>Increased</td>
</tr>
<tr>
<td><strong>Enhancement</strong></td>
<td>Present</td>
<td>Absent</td>
</tr>
</tbody>
</table>
Holes in the distal femoral epiphysis?
Preossification Changes
(posterior femoral condyles)
Epiphyseal Osteomyelitis

- Chondro-osseous junction
- Marked marrow edema
Normal Epiphyseal Development

- High T2 signal with active ossification
  - Posterior femoral condyles
Normal Epiphyseal Development
(Courtesy of Victor Ho, MD)
Developmental Irregularity of Femoral Ossification

- More lateral than OCD
- Coronal:
  - spares intercondylar notch
- Sagittal:
  - posterior to tibial eminence
- “Puzzle piece”
- Intact overlying cartilage
- No edema
Irregular Ossification vs. Osteochondritis Dissecans

- 2-12 yr.: early stress?
- OCD precursor? Apparently not.

# Ossification Variant vs. OCD


<table>
<thead>
<tr>
<th></th>
<th>Ossification Variant</th>
<th>OCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>g&lt;10, b&lt;13</td>
<td>&gt;8</td>
</tr>
<tr>
<td>Location (1/3)</td>
<td>Posterior</td>
<td>Middle</td>
</tr>
<tr>
<td>Epiphyseal Cartilage</td>
<td>&gt;10%</td>
<td>&lt;30%</td>
</tr>
<tr>
<td>Marrow Edema</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Depth</td>
<td>Deep</td>
<td>Flat</td>
</tr>
<tr>
<td>Other</td>
<td>Spiculation</td>
<td>Intracondylar lesion</td>
</tr>
<tr>
<td></td>
<td>Puzzle pieces</td>
<td>Disruption of secondary physis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wide cartilage</td>
</tr>
</tbody>
</table>
15 y/o female
Criteria for Lesion Instability
Adult Osteochondritis Dissecans (De Smet)

- Large (> 2 cm)
- Cartilage breach
- SI deep to fragment more intense than joint fluid
- Cysts in the adjacent femoral condyle
Juvenile Osteochondritis Dissecans: Instability

- Rim surrounding lesion
  - Same SI as joint fluid
  - Surrounded by outer rim of low SI
  - Breaks in the subchondral bone plate
- Cysts surrounding the OCD lesion
  - Multiple and large (>5 mm)
  - High sensitivity but low specificity for depiction of unstable lesions
Unstable Lesion – T2

- High SI deep to the fragment
- Low SI rim parallel to it
- Break in subchondral bone
- Large cysts
<table>
<thead>
<tr>
<th></th>
<th>Stable</th>
<th>Unstable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid SI rim</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Peripheral low SI margin</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Subchond. bone discontinuity</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Cysts &gt; 5 mm</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

Radiology 2008;248(2):571–8
14-year-old with pain after a fall
14-year-old with popping sensation while running
Acute Osteochondral Knee Injuries

- 34% of MRI for trauma
- Separation often at chondro-osseous junction
- Sometimes involves subchondral bone
- Fragment matches injury
Regarding distal femoral irregularities, which of the following is true:

1. In OCD, the loose fragment and the osteochondral defect fit like puzzle pieces.
2. Disruption of the subchondral bone is a sign of unstable OCD.
3. Most osteochondral fractures disrupt a portion of the subchondral bone.
4. Developmental irregularities are more frequent in the anterior femoral condyles.
Regarding distal femoral irregularities, which of the following is true:

1. In OCD, the loose fragment and the osteochondral defect fit like puzzle pieces
2. Disruption of the subchondral bone is a sign of unstable OCD
3. Most osteochondral fractures disrupt a portion of the subchondral bone
4. Developmental irregularities are more frequent in the anterior femoral condyles
Good, bad and ugly epiphyses

- Continuum between developmental change and disease