A Slipped Hip:
Evaluation, Treatment, and Complications of Slipped Capital Femoral Epiphysis

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Agenda

• **Patient Presentation**
• **Anatomy Review**
• **Slipped Capital Femoral Epiphysis**
• **In Situ Fixation**
• **Intertrochanteric Flexion Osteotomy**
• **Complications**
Our Patient: Presentation

• 16 yo boy, who felt a sudden increase in left hip pain while going down a set of stairs, fell down and was unable to arise

• HPI:
  – 3 years of thigh pain and five months left groin pain

• Physical Exam:
  – Lying on stretcher with left leg externally rotated
  – Left leg can not be moved due to extreme pain
Pediatric Hip Pain: Differential

- Irritable hip
- Slipped capital femoral epiphysis
- Legg-Calve-Perthes disease
- Septic arthritis
- Tuberculous arthritis
- Osteomyelitis
- Juvenile spondyloarthritis/rheumatoid arthritis and chronic arthritis
- Idiopathic chondrolysis
- Idiopathic protrusion acetabuli
- Trauma
- Hip dysplasia
- Non-organic syndromes
- Osteoid osteoma
- Osteonecrosis
- Maligancy
- Acute transient osteoporosis
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Anatomy Review: Hip Joint

Gray, Henry Gray's Anatomy: Descriptive and Applied (Philadelphia: Lea & Febiger, 1913) 327
Accessed from http://etc.usf.edu/clipart/
Radiographs (AP and frog lateral views) are needed to further evaluate our patient...

Our Patient: Initial Findings on AP Pelvis

What is wrong with this picture?

The left hip is abnormal
Bending of the femoral neck due to remodeling
Irregularity of the physis

What is going on?
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Overview of SCFE

• **Definition**
  – Femoral capital epiphysis displaces *inferiorly and posteriorly*
  – Femoral neck moves upward and outward while the head remains within the acetabulum

• **Symptoms**
  – Pain in hip or groin
  – Change in hip range of motion

• **Complications**
  – Osteonecrosis
  – Chondrolysis

http://www.eorthopod.com/content/slipped-capital-femoral-epiphysis
Overview of SCFE: Epidemiology

- Incidence is 2 per 100,000 in general population
- Higher incidence in Northeastern U.S.
- Higher incidence among African-Americans
- Males > Females
- Obesity is greatest risk factor
  (2/3 of patients are over 90th percentile in weight-for-age profiles)
- Typically occurs during adolescence
  (age of maximal skeletal growth)
Overview of SCFE: Etiology

- **Unknown, but there are hypotheses...**
- **Mechanical Factors**
  - Relative or true **femoral neck retroversion**
    (more common in obese children)
  - Adolescent **change in orientation** of the capital epiphysis and physis on the femoral neck
  - Alteration of **mechanical strength of physis**
- **Endocrine Factors**
  - Based on common association with **obesity and adolescent growth spurt**
  - Associated with hypothyroidism, growth hormone deficiency, and chronic renal failure
**Classification of SCFE**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acute (&lt; 3 weeks)</strong></td>
<td>- Sudden, severe, fracture-like pain in upper thigh</td>
</tr>
<tr>
<td></td>
<td>- Minor prodromal pain</td>
</tr>
<tr>
<td><strong>Chronic (&gt; 3 weeks)</strong></td>
<td>- Months of vague groin/thigh pain and limp</td>
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<tr>
<td></td>
<td>- Femoral neck remodels (“bending of the neck”)</td>
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<td></td>
<td>- Most frequent presentation</td>
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<tr>
<td><strong>Acute on Chronic</strong></td>
<td>- &gt; 3 wks prodromal pain with sudden exacerbation</td>
</tr>
<tr>
<td></td>
<td>- Radiographic evidence of both femoral neck remodeling and displacement of capital epiphysis</td>
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*Our patient has an acute on chronic slip.*
Functional Classification of SCFE

- **Stable**
  - Able to bear weight at time of presentation

- **Unstable**
  - Unable to bear weight following acute episode
  - Increased likelihood of developing avascular necrosis as a complication

*Our patient’s slip is unstable.*
Diagnosing Our Patient: **Klein’s Line**

Klein’s line, drawn parallel to the superior femoral neck on the AP view of the pelvis intersects the lateral capital epiphysis in a normal hip.

- **Normal**: Klein’s line intersects the capital femoral epiphysis of the femoral head.
- **Abnormal**: Klein’s line does not intersect the capital femoral epiphysis of the femoral head.
How bad is our patient’s slip?

Let’s measure the Southwick angle...
Southwick Angle: Modified Head-shaft Angle

- The Southwick angle is a radiographic measurement used to measure the severity of SCFE on a radiograph.

<table>
<thead>
<tr>
<th>( \alpha_2 - \alpha_1^* )</th>
<th>Morphologic Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 30°</td>
<td>Mild</td>
</tr>
<tr>
<td>30° - 60°</td>
<td>Moderate</td>
</tr>
<tr>
<td>&gt; 60°</td>
<td>Severe</td>
</tr>
</tbody>
</table>

*If contralateral hip is not normal or not measured, angle is compared to normal value of 10°.

Normal hip head-shaft angle = \( \alpha_1 \)
Abnormal hip head-shaft angle = \( \alpha_2 \)

Head-Shaft angle difference = \( \alpha_2 - \alpha_1^* \)

Our Patient: Southwick Angle on Frog Lateral

Frog lateral view of left hip

Southwick angle = 70° - 10° = 60°

α1 = 10° used because frog leg radiograph of normal right hip unavailable

Our patient has a severe slip!
How do we treat our patient?
Treatment Options

• **Prevention of further slippage**
  – In situ percutaneous fixation with pins or screws (most common treatment)

• **Reduce degree of slippage**
  – Closed reduction
  – Open reduction
  – Osteotomies

• **Salvage treatment**
  – Hip arthrodesis
  – Total joint arthroplasty
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Our Patient’s 1st Treatment: In Situ Fixation

– Fluoroscopic visualization during percutaneous screw fixation

Guidewire placed through the base of the femoral neck

A single fully threaded cannulated screw is placed perpendicular to the plane of the physis
Our Patient: Post-op Radiograph

- Radiographic confirmation that the screw tip has not penetrated the joint space is mandatory

*Joint penetration puts patients at risk for chondrolysis

Our patient’s screw is in the right place!
Unfortunately, our patient is at risk for osteonecrosis given the severity of his SCFE and will need further surgery...
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CT with 3-D reconstruction used for preoperative planning
Intertrochanteric Flexion Osteotomy

Femoral osteotomies are realignment procedures used to normalize the anatomic relationship between the femoral head, neck, and shaft.

The intertrochanteric flexion osteotomy is an extracapsular procedure (reduces risk of AVN).

Our patient: Post-op

Synapse PACS @CHB
AP Pelvis Supine
There is risk of contralateral slip even in asymptomatic patients.

Some patients receive prophylactic treatment of the contralateral hip...
Companion Patient #1: SCFE on AP Pelvis

12 year-old boy with unstable slipped capital femoral epiphysis
Companion Patient #1: Prophylactic Treatment

Open reduction left unstable slipped capital epiphysis via surgical dislocation approach

Prophylactic in situ pinning right proximal femoral epiphysis.
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Companion Patient #2: Severe SCFE

10 year-old girl with severe, unstable SCFE of the left hip s/p open reduction using surgical dislocation technique and fixation, and prophylactic pinning of the right hip...
Companion Patient #2: AVN

Patient developed avascular necrosis of the left femoral epiphysis with collapse
One more example of a complication...
Companion Patient #3: Complication of Prophylactic Pinning

14 year-old boy with left SCFE s/p left in situ pinning and right prophylactic pinning

Abnormal wedge-shaped area of lucency within the right femoral head concerning for subchondral fracture (as can be seen in early avascular necrosis)

This is the prophylactic side!
Companion Patient #3: AVN on MRI

Screw removed so hip could be assessed using MRI

Wedge shaped defect with abnormal signal within the central femoral head near the tip of the screw tract is consistent with an area of avascular necrosis.

MRI T1 Coronal Right Hip
Companion Patient #3: AVN on AP Radiograph

Most recent clinic visit shows the patient has central osteonecrosis of right femoral head and will require long-term follow-up.
Acknowledgements

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References

5. Gray, Henry Gray's Anatomy: Descriptive and Applied (Philadelphia: Lea & Febiger, 1913) 327