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INTRO TO PEDIATRIC MSK RADIOGRAPHS: APPROACH TO HIP RADIOGRAPHS

Developed by Dr. Kai Homer for PedsCases.com.
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Introduction:

Hi, my name is Dr. Kai Homer, and I'm a resident in Radiology at the University of Alberta. This video is the seventh in a series discussing musculoskeletal radiology in children. We're going to focus on musculoskeletal injuries and going through some cases to help you understand how radiology fits into the whole clinical picture. This first video will discuss terminology used to describe fractures in radiology, focusing on some concepts that are specific to pediatrics.

This module was reviewed by Dr. Adrienne Thompson, a pediatric radiologist at the University of Alberta. I'd like to thank the University of Alberta Department of Radiology for allowing access to images from real cases. All images have been de-identified and are used here for educational purposes only. These slides are available at www.pedscases.com and on the Canadian Association of Radiologists website.

After watching this video, the learner should be able to:

1. Recognize and describe the radiographic presentation of Legg-Calve-Perthes disease
2. Recognize and describe the radiographic presentation of Slipped Capital Femoral Epiphysis
3. Stratify hip abnormalities according to presenting age of symptoms
4. Identify the normal appearance of the pediatric hip on radiographs

Let's start off with a case.

Case 1: A **five-year-old girl** is brought into the emergency department by her parents because of a limp affecting her left leg that has come on gradually. She has only complained of minor pain, and is not fussy in the exam room. On physical exam, you notice that when she walks, she has a Trendelenburg gait and she has limited internal rotation and abduction of the left hip. So here we have an AP radiograph of the pelvis. For reference, this is the normal side, the right side. Now, comparing to the affected side, which is the left side, we can appreciate that the acetabular roof is flattened and you can appreciate the smooth curved acetabular roof on the normal side. You can see the difference between the two on this slide. The markedly irregular, poorly defined, fluffy appearance of the left acetabulum is due to chondrolysis of the femoral

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head and development of premature arthritis. The acetabular roof is not the only thing that gets flattened in this condition. One of the changes that occurs is known as asphericity of the femoral head, which means loss of sphere-like-ness, basically meaning that the normal spherical shape of the femoral head gets squashed. You can appreciate the difference between the nice sphere shape of the right femoral head and the more compressed shape of the left femoral head. Another way to tell that this is happening is just to compare the epiphyses. Notice that the left epiphysis is more white, more radiodense. Whiter bone in x-ray lingo is known as sclerotic bone. On top of everything else in general the left femoral head looks fragmented and chewed up compared to the relatively smooth right side. This indicates there is some osseous destruction occurring. These x-ray findings are classic for **Legg-Calve-Perthes disease or LCP** for short. In LCP, the hip joint space may also widen. This case does not show that particular finding. Metaphyseal lucency, seen medially here, but more characteristically seen on the lateral side, implies impaired endochondral ossification and again suggests LCP. This is a frog leg lateral view, which allows better visualization of the femoral head to look for the subchondral crescent sign, which indicates impending articular surface collapse. On this view, you can appreciate the joint space widening on the left hip.

Case 2:- the following patient is **a nine-year-old** boy that is limping with no history of trauma. You're on your emergency medicine rotation, and naturally you suggest to order x-rays of the pelvis. Here we have the AP radiograph of the pelvis and you can see radiolucencies that represent the greater trochanter apophyses and these radiolucencies here are the proximal femoral physes. You'll note how there are subtle widening of the left proximal femoral physis compared to the right. Wait why are we even comparing in the size of the physes left to right? We care about the size of the physes because of a condition you may have heard of, known as **slipped capital femoral epiphysis**. Klein's line is a tool that is used to assess for the presence of slipped capital femoral epiphysis, or SCFE for short. Klein's line is drawn parallel to the lateral femoral neck along the superior aspect of the metaphysis. This line should intersect the femoral epiphysis in normal patients. Here, on both the right and left, Klein's sign intersects the epiphysis. On a normal AP view, in early SCFE, before much of slipping has occurred, Klein's line can be normal. A more sensitive test is the modified Klein's line - this compares the width of the epiphysis lateral to the traditional Klein's line side to side. A difference of more than 2 mm is suggestive of SCFE. In this particular case, that was also negative. This is a frog leg lateral view coned down on the left hip. The frog leg view is a lateral view of the femoral head and neck that increases the sensitivity of x-rays to detect SCFE. In SCFE, the slippage actually occurs in the AP front-to-back direction which is captured on the frog leg view. The Southwick angle is used on the frog-leg view to measure the displacement between the femoral head and the femoral shaft. In SCFE, the Southwick angle will be greater than zero as shown here. Southwick angle measurements can classify the severity of the slip. Normal pre-slip is 0°, mild would be less than 20°, moderate would be between 30 to 50°, and severe would be over 50° on this measurement. So what is

SCFE? Slipped capital femoral epiphysis is a displaced Salter I fracture of the femoral capital epiphysis. Most cases are thought to be due to sheer stress. Every time you wait bear on your leg, there's upwards force directed against the lateral end and on the medial end you have the weight of the torso pushing down. The proximal femoral physis sits on an angle.

SCFE is one of the most common hip conditions in teens, in females it can occur from anywhere from 8 to 15 years old, in males it can occur anywhere from 10 to 17 years old. The average age and girls is 11 to 12, and the average age in boys is 13 to 14. As SCFE gets worse over time, so do the x-rays. Early changes include mild widening and irregularity of the physis. Late changes include the epiphysis slipping posteriorly and medially. SCFE occurs bilaterally in 20 to 40% of cases. In these kids, the contralateral slip usually occurs within two years from the initial SCFE.

This is a more severe case of SCFE. Take a look at the right femoral epiphysis and metaphysis. If we compare these structures to an ice cream cone, where the metaphysis is the cone and the epiphysis is the ice cream, you can appreciate how the left femoral epiphysis demonstrates the classic appearance of ice cream that is slipping off a cone. This case was treated with surgical pinning. On the right, a pin was placed prophylactically. This practice is sometimes followed due to a risk for the same thing happening on the other side. On the left, the affected side, the pinning is done to prevent the slip from going any further and possibly disrupting blood supply, to avoid osteonecrosis.

Of course with every important injury, there's always at least one dreaded complication. For SCFE there are 3.

1. 32% of kids with SCFE will go on to get **femoroacetabular impingement**
2. 7 - 10% of kids with SCFE will go on to get **chondrolysis** and
3. 3 to 58% of kids will go on to get **osteonecrosis**.

Chondrolysis just means narrowing of the joint space and loss of articular cartilage. Osteonecrosis is the most serious complication of SCFE, in both cases it's thought to be due to a disruption of the vascular supply either as a result of the injury itself or iatrogenically during surgery. It may occur in untreated SCFE and end as a complication of surgical pinning. Unstable SCFE is defined as a child not being able to walk even with crutches, it increases the risk of osteonecrosis.

This concludes part 6 of this video series. In the next video in this series we will look at non-accidental injury. Before we leave, we wanted to leave you with a few key take home points

- 1) Radiographic features of Legg-Calve-Perthes disease include asphericity of the femoral head and flattening of the acetabular roof

- 2) Early SCFE can be detected on radiographs by comparing the width of the epiphyses bilaterally
- 3) Severe SCFE can be recognized by the classic “ice cream cone” sign

Thanks for watching part 7 of the pediatric MSK radiograph series on PedsCases, and please stay tuned for the rest of this series.

1. Silva MS, Fernandes AR, Cardoso FN, Longo CH, Aihara AY. Radiography, CT, and MRI of hip and lower limb disorders in children and adolescents. Radiographics. 2019 May;39(3):779-94.

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