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INTRO TO PEDIATRIC MSK RADIOGRAPHS: APPROACH TO SHOULDER 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 second 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. Describe an approach to interpreting pediatric shoulder radiographs
2. Recognize common injuries to look for when viewing pediatric shoulder radiographs
3. Recognize the anatomic structures visible on pediatric shoulder radiographs

In this module, we're going to review our approach to pediatric shoulder radiographs. I've broken this approach up into four sections. We'll start first by looking at the bone cortex, then next, we'll look at the clavicles. After that, we'll look at the proximal humerus. Finally, we'll look at the glenohumeral joint.

Let's start off with an AP radiograph of a left shoulder in a teenage boy, for reference. Here, I've traced the major structures. The clavicle is in green, the humerus is in blue, and the scapula is in yellow. I've highlighted three parts of the scapula: 1 – the coracoid process, 2 – the acromion and 3 – the glenoid. So, step one of our approach to pediatric shoulder involves carefully looking at all the bone cortices for any breaks or steps indicating a fracture. So, here I've drawn solid lines along the cortex, so this is where we would be looking for those steps or breaks. Step two of our approach is to focus on the clavicle, and the reason for this is because the clavicle is the most commonly broken bone in the pediatric shoulder. You want to look for any break in the cortex of the clavicle and you're going to want to look at the sternoclavicular (which I've highlighted in blue) and acromioclavicular (highlighted in pink) joints to ensure alignment is well-maintained.

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Because proximal humerus fractures are common in kids, our third step is going to involve looking specifically at the humerus, looking for any cortical breaks, and paying attention to the epiphysis, highlighted in pink, the metaphysis, highlighted in green, and look for any widening of the the physis, which I've highlighted in yellow. Proximal humerus fractures tend to involve the growth plate, which makes them Salter-Harris fractures by definition. Last but not least, we'll take a look at the glenohumeral joint, and make sure it is well aligned like it is in this example. The humerus should fit into the curve of the glenoid. On the frontal view, the humerus and glenoid should overlap and make a lens shape. Using the pink color, I've highlighted where the two structures overlap.

Case 1

Now let's look at a case. Here we have a 16-year-old boy presenting to his family physician with a history of chronic shoulder pain. He has a past medical history of epilepsy diagnosed at age 9.

So this is a special view of the shoulder known as the true AP view, or Grashey view, of the left glenohumeral joint. Here, I've highlighted some major structures - the clavicle in green acromion in purple, the coracoid in yellow, glenoid in pink, and humerus in blue. To understand how the true AP view is taken, let's use this diagram. Imagine we're looking down at the patient from a Birdseye view while they are getting their x-ray. The patient is standing in front of a detector and if you imagine that we're looking down at the patient, if they rotate 35 to 40° to their left (to the side of the shoulder being imaged), in this case the x-ray beam is going to line up perfectly with the shoulder joint. Here, I've highlighted some anatomy on a 3D reconstruction to help you get oriented. The clavicles are outlined in green, the acromion is in purple, coracoid is in yellow, glenoid is in pink, and the humerus is in blue. So, if we go back to our x-ray now, on this view of the shoulder, it should show space between the humeral head and the glenoid. Instead, you can see how the humeral head abnormally overlaps the glenoid rim. This view is known as the scapular Y-view - it is as if we're standing behind the patient looking forward, so the glenoid is on the other side of the scapula. So I've highlighted the scapula in yellow, the acromion and coracoid are seen there, and I've outlined where the glenoid fossa would be on the scapula. Normally, the humeral head should be centred over the glenoid as shown here, but in this case the humerus has dislocated posteriorly. The scapular Y-view shows us that the left humerus is posterior to the rough approximate centre of the glenoid. That confirms the diagnosis of posterior shoulder dislocation. In this case, there are bilateral posterior shoulder dislocations. We're looking at a CT from this case, here I've taken two axial CT cuts taken at slightly different levels through the glenohumeral joint which clearly show bilateral posterior shoulder dislocation.

Case 2

Let's look at a second case. So, a 12-year-old male comes in with left shoulder pain and he's unable to use his left arm. On exam, you find localized tenderness to palpation of the left proximal arm and decreased range of motion of the left shoulder. All pulses are present and sensation is preserved. A radiograph is ordered. So, here we have an AP view of the left shoulder. When I zoom in here on some areas of this radiograph, you'll notice how,

compared to the area I've highlighted in yellow, the area I've highlighted in blue looks more darker gray. That means it is made up of less dense bone than normal bone marrow, normal bone marrow being what's inside the yellow box. So, this lesion that we see here in the shoulder would be considered a lucent lesion because it's less dense than the surrounding bone. What does lucent mean, though? If we pretend this rectangle is bone and there's a lesion here in the middle of it. This lesion appears whiter on the x-ray, because there's more material, which makes it denser. So, denser structures look brighter, or whiter, same thing, on x-ray. This lesion would be considered a sclerotic lesion. Now, if in this area, normal bone has been replaced with a bone cyst. Because the bone cyst is less dense than the surrounding bone, less dense structures appear blacker, or darker gray, on x-ray. So here we have lucent vision arising in the centre of the medullary cavity, and this is actually a unicameral bone cyst otherwise known as a solitary bone cyst. This is a benign fluid-filled bony lesion seen in kids. They typically occur in the metaphysis of the long bones, most commonly the humerus, as seen in this example. They tend to occur near the growth plate. Unicameral bone cysts commonly present as a pathologic fracture as seen in this case. This radiograph illustrates the fallen fragment sign, where a fallen fragment of bone is seen floating in the liquid inside the cyst. This fragment will remain dependent under the effect of gravity no matter how the x-ray is taken. Here, we have a slightly different view of the same patient's arm, showing the fallen fragment of bone floating at the bottom of the cyst.

This concludes part 3 of this video series. In the next video in this series we will look at ossification centres of the elbow. Before we leave, we wanted to leave you with a few key take home points

- 1) A 4-part approach to pediatric shoulder radiographs is helpful to ensure all areas are looked at: 1. Bony cortex 2. Clavicle 3. Proximal humerus 4. GH joint
- 2) The clavicle is the most commonly fractured bone in the pediatric shoulder
- 3) Proximal humerus fractures are a common type of Salter-Harris fracture to look for on pediatric shoulder radiographs

Thanks for watching part 3 of the pediatric MSK radiograph series on PedsCases, and please stay tuned for the rest of this series.

References:

1. Zember JS, Rosenberg ZS, Kwong S, Kothary SP, Bedoya MA. Normal skeletal maturation and imaging pitfalls in the pediatric shoulder. Radiographics. 2015 Jul 14;35(4):1108-22.
2. Pretell-Mazzini J et al: Unicameral bone cysts: general characteristics and management controversies. J Am Acad Orthop Surg. 22(5):295-303, 2014

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