ICSC IMAGING Module 3
Section 6_ICSC03
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Video Lesson: 1:01:20

ICSC03-Section6-ShoulderUpperExtremity.txt

Welcome back to our next instalment, we are going to be getting into Upper Extremity Trauma, starting with the shoulder girdle and working our way down.

As we are looking at different shoulder injuries, one of the things before we even get into looking at shoulders, just doing an anatomy overview, this is very important when we start dealing with the shoulder, and we will see some of the other joints in the lower extremity plays a valuable role when we are dealing with a lot of the osseous injuries. But realizing that a lot of the injuries that we see in the lower extremity are well upper extremity, they tend to be soft tissue injuries. It is where we know that we are going to wind up in a lot of these cases having to get advanced imaging tools to help us decide what is the diagnosis and how is this going to affect the prognosis.

One of our other options is we can also start looking at the musculoskeletal ultrasound. With MSK ultrasound, it is an excellent modality for looking at the shoulder structures, realizing again, very operator-dependent, and something that takes a lot of time to learn how to do effectively. I am not going to be getting into the ultrasound side of things but realize if you do have an imaging centre in your area that utilizes musculoskeletal ultrasound, it is a fantastic modality, if you have good operators and good readers. What I would like to start off with is a live DICOM demonstration, looking at an MRI of the shoulder.

I am going to be running it through a shoulder arthrogram. Because this study, it is a very high-quality study and shows us a lot of the different structures we need to see. Realize when it comes to imaging the shoulder, most of the time, we are just going to order a standard shoulder MRI, we generally do not need contrast, unless we are looking for tumours or infections. The big question is do we do an arthrogram, where they inject the contrast material into the joint capsule? The answer for that one is if I am looking for labarum pathology, or if I am looking at osteochondral defects, those are the big times that we would be starting to look at putting the arthrogram into the shoulder. What it does highlights the cartilaginous structures more effectively, it also lets us look to see if there any tears in the labarum is their extravasation of material, and so forth. Because we are looking at an arthrogram here, some of the pulse sequences are a little different than we would see on a standard shoulder. Not surprisingly, on a standard shoulder MR, we are going to be looking at T1s and T2s, some cases, proton densities, and then we will be looking at different planes.

One of the things to realize when we start looking at the different planes in the shoulder, the axial plane is the conventional axial plane, there is nothing different or unusual about the axial plane imaging, what is a little bit different, pulling a two-up window and we will use the axial to demonstrate orientation. When we look at the coronal the coronal's are actually done in an oblique plane. Because we want to make sure that we are in the plane of the scapula. That way we can really effectively evaluate any of the musculoskeletal structures in that region. The same thing for the sagittal oblique, when we look at the sagittal, it is not going to be a pure sagittal. It is going to be about 30 degrees off the sagittal plane because of that way we are getting a tangential slice through the areas of question.

Now Just to do some anatomy review so that we also understand what is the best pulse sequence to see different kinds of structures. The axial, when we start off in the axial coming, it is starting at the top and working our way down. The axial lets us see, we can see acromion and the clavicle AC joint very nicely. It lets us get a good evaluation of infraspinatus and teres minor on the backside through here. It also lets us get an excellent visualization of the subscapularis tendon. We can see the anterior and posterior portions of the glenoid labarum. We want to make sure that we do not confuse the anterior labarum with the middle glenohumeral ligament. This little lighter area through here is very frequently misdiagnosed as

a labral tear, but it is just a gap between a ligament and the labarum. We are seeing of course the hyaline cartilage of the humerus and the glenoid. This is an arthrogram, so there is a contrast to standing the joint capsule here.

We can also see the bicipital groove with the long head biceps tendon, and this allows us to evaluate is there Bicipital tendon subluxation or dislocation. Then we continue on them as we will see the various muscles compared to comprising the shoulder region, we will sometimes see a little bit of lung. An important thing to do is when you are evaluating these always make sure you do look for lung pathology. It is a big deal on shoulder x-rays to keep in mind that a lot of things in the chest will refer to the shoulder, so we want to make sure we are evaluating for those.

The coronal oblique, we always run into the first question which is, so where am I? Well, one of the easiest things to do, is when you are trying to figure out where you are, pull up a localizer. Here you see the core code that is in the front. I can always just use the localizer lines. If you are using a single window, and you are trying to figure out where you are, pan through the image until you find something that you know, whether it is from the front or back, there we go, there is the coracoid, so I know I am in the front of the shoulder. There is the coracoclavicular ligament complex. We are seeing shorthead biceps there, as we go backward, we are seeing the subscapularis tendon.

A really important ligament here that is very understated in the shoulder is the coracoacromial ligament here so that coracoacromial ligament can be created as part of the coracoacromial arch, and it can create impingement on the supraspinatus tendon, particularly if a person is developing. In these a fight on the inferior aspect of the acromion, we look at the slope of the acromion. The types of the acromion, we tend to downplay that the type one type two type three, that gets downplayed these days, the literature tends to support that not being as important as it used to be thought, the thing that is believed to be more important from a shoulder impingement syndrome standpoint, is the slope of the acromion. How angled down is it? and how much does it cover the humeral head?

Right through here, we are getting into the humeral head, and we are seeing part of the bicipital groove, and that is the long head biceps tendon, taking the turn from vertical to horizontal. The horizontal component is coming across here, and this is where it ties into the long head biceps anchor, which is associated with the superior portion of the glenoid labarum. The inferior portion of the labarum we also see through here. Now not surprisingly, of all the shoulder muscles, what is the one that is most clinically significant, Supraspinous. When we are dealing with patients with shoulder pain, well, we can see the supraspinatus very nicely in profile, so supraspinatus muscle belly, coming down into the musculotendinous junction and inserting onto the URS, and then as we turn the bend here, we can see that this is Infraspinatus. As I follow this through, here is Infraspinatus, and then there is Supraspinatus.

We can really make our distinctions between the various tendons as we look at that coronal plane, the sagittal plane, we are starting on the outside of the shoulder in the deltoid, seeing the humeral head. As we travel forward, here is the long head, biceps tendon, and you can see where it travels up. One of the big tricks on MRI is if you ever get a chance to sit down with a radiologist, as they are going through a shoulder MRI, one of the things you will notice is we tend to pan back and forth through the entire stack of images continuously. That is because what we are doing is we are following one structure. We look at one structure, we follow that all the way through, then we go to the next structure, follow that all the way through, and that way rather than trying to see what everything is, I want to evaluate every different anatomic structure on this one slice. I follow that one thing, and I can check that for pathology and then all fall, go through and do the next step.

Presentation placement: 09:03
We are coming into the humeral head now. You can see, of course, the Fasil scar where the growth plate used to be epiphysis and metathesis. Now coming through here, we saw that the long head biceps tendon took a turn, and there is the horizontal component. subscapularis, supraspinatus, infraspinatus teres minor, there is a little bone Island and this person’s humerus. As we are getting in, we are coming in towards the

anchor, and now we are right at where the long head biceps tendon inserts onto the superior portion of the glenoid.

Coming back the more into scapula at this point, you can see the supraspinatus muscle belly, subscapularis, infraspinatus teres minor, coming down right through here. There is the long head of the triceps origin coming off the inferior aspect of the glenoid and this is an important thing to consider. Because it can be implicated in the end, some shoulder dislocation style injuries, and last lace on through here we can see those coracoclavicular ligaments, which we are going to talk about a little bit when we get into the ac joint injuries. It is possible to see brachial plexus to varying degrees depending on the shoulder study, you are looking at the orientation and the slice thickness, and you can see some brachial plexus.

One of the interesting things right now is that we are seeing a lot of axillary lymphadenopathies, particularly surrounding COVID injections when we are looking at vaccinations. One of the things that a radiologist should be reporting on is how many, are we seeing a lot of lymph nodes in the axilla. That is something that the clinician then has to follow up with, to see if there is a cause for the lymphadenopathy such as a recent immunization. That is our light overview of shoulder MRI, and I am going to be doing several live DICOM demonstrations through the course of the shoulder.

To start getting into some specific injuries, let us start with where does the shoulder kind of join the body? **Well, the SC joint**. We will start looking at the clavicle and work our way out from there. The sternoclavicular joint, it is uncommon in most sporting events to damage the sternoclavicular joint is something we do see things like motor vehicle accidents, where seat belts can damage the sternoclavicular joint. But in most sporting events it is rare and sprains strains. Sure, but true SC joint injuries are rare. The big thing we look for there is dislocation which has a tendency if it does dislocate the posterior. The problem is it is a difficult area to visualize with an x-ray, so we tend to go to CT or MRI if we need to evaluate the SC joint.

Clavicle fractures are incredibly common. Recognize what are some of the common locations to find those clavicle fractures, and then we will look into AC joint injuries. With clavicle fractures, we break clavicle fractures into three different types. The medial clavicle, the middle clavicle, and the distal or lateral portion of the clavicle. The more proximal portion, the medial part of the clavicle, is incredibly uncommon to fracture just like it is uncommon to see sternoclavicular joint injuries. This does not fracture that often gives it a very protected area, the middle third, a right where we see the **S bend** in the clavicle, that is a mechanically disadvantaged area. A lot of really complicated force goes through that because of the bend in the clavicle at that point. So that is where we are going to see most fractures.

The distal third of the lateral part of the clavicle, is it possible to fracture course, is it likely, NO. What will typically happen is, instead of the distal clavicle fracturing, we will see AC joint injuries. That is one we want to be aware of, "Okay, what are some commonalities?" We know that the middle third of the clavicle is the one that is most commonly going to be fractured, and quite often, when you clinically look at the patient, you will know right away that the person has a middle clavicle fracture because there is going to be some clinical offset, you might see some swelling in the area, and that makes it interesting and evaluate.

How do you fracture the clavicle? The two big ways. If at any point in time during the upper extremity lecture, you ask yourself, "**What is the mechanism of injury**?" and you cannot really remember what it is, just go for the default answer, the person FOOSHED, meaning "**Fall on outstretched hand**". That is our classic mechanism for a lot of the things that happened in the upper extremity, and the interesting thing was, if you think about this, in comic book terms, if you are drawing somebody who was falling on an outstretched hand, they will probably have a little bubble around them and went FOOSH, it is the sound that you kind of make when you fall.

Fall on an outstretched hand, will do a lot of things. The other big thing that could damage the clavicle and by extension, also the AC joint is a shoulder pointer. This is where when somebody is falling, and

they land right on the point of the shoulder. Think about it from like a gymnastic standpoint. If you are going to do some tumbling, you tuck your shoulder so that you can tumble effectively across your shoulder. We will also see this a lot in martial arts. If you **do not** get the shoulder tucked in, you land right on the point of the shoulder. That puts a lot of force through that clavicle. That is what I did myself during my little stint in martial arts.

When we start looking at these clavicle fractures, here is a nice example of a proximal middle third clavicle fracture again, very, very uncommon. Here is the big one, this is the middle clavicle fracture. When we start to see that middle clavicle fracture, in this case, this was an equestrian event. We can see in this case, that one of the things that happen quite often when we are dealing with these middle clavicle fractures is the sternocleidomastoid contracts and pulls the proximal portion up, and the weight of the shoulder pulls the distal portion down. Then the pecs traps and rhomboids pull the shoulder a little bit medially. What we see is this finding here called bayonet acquisition, that is where the two parts of the bone offset and overlap, so a bayonet is a knife that you put on the end of a rifle. It is where the handle overlaps the barrel. We are seeing that bayonet acquisition in most of these cases, and that bayonet opposition comes with its own problems in that, try to get this thing to reduce. One of the big questions in orthopaedics is, do they repair clavicles like this? Or do they allow them to heal? There is a big orthopaedic debate on, should these be repaired, or should they be left to heal as is or non-union? It is kind of an interesting phenomenon.

Let us show you what will happen if these are left on their own. This is a friend of mine who is not a sports-related injury. This was a motor vehicle accident. My friend here T-boned somebody at 60 miles an hour, broke 20 ribs and the seatbelt broke his clavicle. You can see where he healed in a malunion pattern. Any person had that persistent bayonet acquisition, and this is where we can see, and this is one of the associated problems that we are concerned about in patients that have this bayonet opposition healing if you can imagine thinking about where his brachial plexus runs. Brachial plexus is running right down through here, and I am not going to draw the cords and divisions and routes and all that kind of stuff. This can impinge on the brachial plexus, and then one of the concerns would be doing this person develops post-traumatic Thoracic Outlet Syndrome?

As we get a little further out into the distal portion of the clavicle and distal clavicle fractures are uncommon. What we are going to see more is we are going to see AC joint injuries. You will see these referred to variously as AC joint separations, AC joint dislocations, there is even always this actually a diastasis rather than a dislocation. I am a big one for calling these AC joint injuries and making my life easy. So, again, **FOOSH** is not shoulder pointers, a major mechanism for shoulder injuries. There are three big grades when we are looking at AC joint injuries, grades 1, 2, and 3, I am going to draw this out in a moment. There is a grades 4 or 5 and 6, those are very rare circumstances. It is where there is complete destruction of the AC and coracoclavicular ligaments. Grade 4 dislocates into the trap, grade 5 dislocates higher up into the posterior trap, maybe even under the neck, and grade 6, goes underneath the acromion. Again, very rare circumstances to find those, and those are usually not difficult to diagnose. The important thing is trying to decide, whether we are looking at grade 1, grade 2, or grade 3.

An important thing when we start dealing with a patient who has AC joint injury is we want to evaluate not surprisingly, AC joint x-ray. Now an important thing with AC joint x-ray is we do these with and without weights. We do just stand in neutral and get an AC joint view, and then we have the person hold a weight to distract the shoulder down. Because one of the things that happen with these AC injuries on any of the one-two or three, one of the things that might happen is the person might actually hurt, they are painful, so they tend to contract and guard, and the clavicle will drop back down to a normal position. As we are evaluating AC injuries, there are two structures that we pay a lot of attention to when we start talking about AC joint injuries. We are looking at the ac joint ligaments and the cortical curricular ligaments. We are not going to separate the coracoclavicular into their two components. We are just going to treat these as one group, so AC ligaments and CC ligaments. As we are looking at these two ligamentous complexes in grade 1. A grade 1 AC injury, is generally a normal-looking shoulder because in grade 1 the person mildly sprains the AC joint, but then the coracoclavicular are left intact, and it'll

look pretty normal. Everything generally lines up where it should, maybe there is a little widening of an AC joint.

Presentation placement 20:13
When we start looking at grade 2, so on grade 2, is a complete rupture of the acromioclavicular ligaments, and a spraining of the coracoclavicular ligaments. What you will typically see then is AC joint widening, and also the partial elevation of the distal clavicle?

The big landmarks that I use when I am trying to discern what kind of AC injuries there are. Notice that on the without weights, this joint loads this one up here, this one looks normal. This is the with weights, you will see this as WW with weights, we can see that there is a change, I use three landmarks. When I am looking at AC joints, I use the bottom edge of the clavicle, the top edge, the acromion, and the bottom edge of the acromion. The bottom edge of the clavicle should line up with the bottom edge of the acromion. If the bottom edge of the clavicle is falling in between the top and bottom edge of the acromion, that is generally agreed to, and then if we take this to our next patient, here, we can see where the bottom edge of the clavicle is completely above the top edge of the acromion. So that is going to be a grade 3.

One of the other things which I am a big fan of is using common sense. You can see this clinically, there is this person who is going to have a large step off their shoulder. This is a patient before I inflict the weighted view on them because it is not going to be comfortable. I would clear that minimal that first AC joint x-ray, let us see how this thing looks before I put weights on and cause the person unnecessary pain.

A really interesting thing that can happen when we start dealing with AC joints, is whether the person has a distal clavicle fracture or an AC joint injury for unknown reasons. Sometimes it creates this kind of over-driven inflammatory reaction. The other big thing that we see this with is cumulative trauma where somebody is repetitively injuring their AC joint. In either case, whether it is post-traumatic or whether it is cumulative trauma, the body creates this inflammatory reaction in the distal clavicle. This creates a phenomenon called PTOC, post-traumatic osteolysis of the clavicle. With post-traumatic osteolysis of the clavicle as that inflammatory reaction starts to happen, a big thing to remember from a bone physiology standpoint is when a bone becomes inflamed, it increases osteoclastic activity.

One of the things that will happen in these patients, either, the person who has got the acute trauma, the pain does not die down the way it should, it gets worse because there is inflammation in the distal clavicle. Or if I get a powerlifter, who is starting to complain about AC joint pain, you need to realize bench pressing is incredibly hard on the AC joint, and that horizontal AB duction really stresses the AC, so powerlifting is kind of notorious for this type of injury. They start getting pain in the area, so it is worth taking some imaging to see what is going on.

I am now looking at two different clavicles right going to be normal for comparison. On the normal side, we can see a nice normal AC joint space with a good cortex all the way around. When I look over on this side, this person has an abnormally widened AC joint. But more importantly, we are seeing that there is no cortex on the distal clavicle. This is a case of post-traumatic osteolysis of the clavicle, PTOC. Now, this generally can come on, after an acute injury of two to three weeks, after enough cumulative trauma you can start to now has an insidious onset. The big thing is this inflammatory reaction can last for about six months and it will erode the distal clavicle and it will create instability of the acromioclavicular joint now just to show you what I am talking about again using an MR perspective on what this thing look like when we look at MR.

What I am giving you here, as we look at the MR, is I am focusing on the sagittal oblique and this is a stir sequence and as I scroll in now this is a very poor-quality MR. This is an open magnet, and its stir stirs are always grainy images. One of the things we can see as we are coming in, so is sagittal. We are starting on the outside slicing in, we notice that there is some inflammatory change, but what is interesting is that here is the clavicle, the clavicle is inflamed, but the acromion itself is not. This is a person who has active post-traumatic osteolysis in the clavicle with that bone marrow inflammatory change. I get the self-

limiting condition; it does go away on its own and generally about six months and it will have some instability in the AC joint as a generally heals. Now, from there we come into shoulder dislocations, now when we know, I am going to bypass scapular fracture scapular fractures, which is self-explanatory.

Usually, the only way to really break his scapula, the body of the scapula least is through direct trauma, we will see a fracture in the glenoid, and just a little bit. But getting into shoulder dislocations with shoulder dislocations, there are four major directions, and in general here we talked about any kind of joint dislocation. We talked about things and Cardinal planes; does it go anterior? Does it go posterior? Does it go superior? Does it go inferior? Well, when we start looking at the shoulder dislocation, the vast majority of these are going to be anterior. It is because the shoulder is angled anterior, the anterior ligaments are weaker than the posterior ligaments, so anterior dislocations are the most common direction.

Posterior dislocations are a very rare, very small percentage, their big thing is anytime we see a posterior dislocation that means, of course, it could be a foot injury because of its upper extremity. But I always want to see this person have a seizure, seizures are a major cause where the contraction will pull the humerus backward and dislocated, and along those lines, if somebody has an electrical shock, that can induce seizure-style activity, and that can create that posterior dislocation. The inferior and the superior are very rare, and it is not a difficult diagnosis. With the inferior dislocation, the arm is stuck up like this person looks like they are always asking a question in class. This is called **Luxatio Erecta** (inferior dislocation of the glenohumeral joint trapped underneath the coracoid and glenoid). It is because the person's arm was AB ducted, and something hit the shoulder and drove it down and it stays up and they cannot put their arm down the superior dislocation to get a true superior dislocation on the shoulder, you have to fracture the spine of the scapula and the acromion. This is not usually a difficult call.

Presentation placement: 27:31
Not surprisingly, radiographs are very important in diagnosing dislocation. We have somebody that has pain in the shoulder, they have limited range of motion after trauma. One of the important considerations, when somebody has an anterior dislocation versus just a simple sprain, is that as the arm is dislocating anterior, it tends to externally rotate a little bit. This person has a little bit of fixation and external rotation, and it is hard for them to internally rotate, because of the way the muscles are going to pull as that shoulder dislocates. We can see the classic subcoracoid location for this shoulder dislocation, not a difficult diagnosis here. The thing that we are worried about them as far as dislocations go, we are worried about fractures that can happen with a dislocation, and we are worried very much about the glenoid labarum. Very common when we see shoulder dislocations that there are going to be labelled pathology. Not surprisingly, once somebody dislocates once, they are more predisposed to having other dislocations, because the ligaments have been damaged. That is why immobilization is one of the keys to treatment to give those ligaments a chance to heal. As we started talking about associated injuries, when we are looking at this when there are three major associated injuries with glenohumeral dislocation, the Hill-Sachs, which is a fracture on the posterior superior portion of the humeral head, where the glenoid impacts the humerus there is the Bankart, which is a fracture of the anterior inferior margin of the glenoid. This can either be direct impaction, or this can be a component of a bulging via the triceps mechanism, and then the flat fracture is where this person evolves as the greater tuberosity with the rotator cuff, the superior rotator cuff tendons.

Other things that we are concerned about, and this is one of the things that must be monitored in somebody with a history of shoulder dislocation. Did they damage the axillary nerve? How is their deltoid doing in the weeks following the dislocation, checking for brachial plexus neuropathy because not surprisingly, again, the brachial plexus is travelling in this direction here? There can be impingement upon the brachial plexus and then damage to the suprascapular nerve as well.

The Hill-Sachs fracture. The thing about the Hill-Sach, is a fracture of the posterior superior portion of the humeral head it is a V-shaped groove, which is exactly what we are seeing here. Because this shoulder dislocated anteriorly, the glenoid acted like a hatchet and rammed into the posterior part of the shoulder,

and that is why that Hill-Sachs is also known as a hatchet fracture. That groove is going to be there for the rest of the person's life, and we will always know that there is a history of dislocation here.

Presentation Placement 30:36

Pulling up a DICOM case, we are now looking at the axial sequence. This is a tee to fat-suppressed as we scroll down, we are in the area of the AC joint, and we are getting down underneath the acromion. Let us see if there is some fluid in this person's shoulder. This was an equestrian injury and they were holding on to the horses' reins. The horse had pulled really forcefully against the reins and dislocated the person's shoulder, we can see as we are coming down through now that notice that there is bone marrow edema on the posterior aspect of the humerus. We can see there is the V-shaped groove where this person has a Hill-Sachs. That Hill-Sachs fracture is going to be there for the rest of this person's life because it does create that groove and it is not like it is going to regrow. We will always know that this person has a history of dislocation.

The Bankart fracture, this one is a fracture of the anterior inferior glenoid RAM, you can see a little defect right through there. The big deal about the bank or fracture is if there is a bank card fracture, 99% probability this person's got labarum pathology because as the shoulder dislocated either the humerus knocked the corner off of the glenoid. Or we can see where the triceps falses, a portion of the glenoid. This is one of those big indicators that if this person's got persistent shoulder pain, I am going to be thinking about getting an MRI arthrogram, and that is one of my big deals is, that anytime I have a patient with a history of dislocation with persistence or shoulder pain, I am going to consider an arthrogram.

Now, the other dislocation, if we are going to see dislocations, anterior is the most common, it is possible to see posterior. Not surprisingly, a posterior can happen with a Fouche. Because as that arm goes out, and you are landing on it, it is forcing the humerus backward. But again, we can see this with uncontrolled muscular contractions with seizures and electrical shock. This is a very difficult fracture to see or difficult dislocation to see because it does not really move out a plane as we see with the anterior. The anterior dislocation, the humeral, headwinds up down here, with the posterior going straight back, and as it goes straight back, it tends to fix it in internal rotation. This person will lack external rotation from a clinical perspective.

The important thing is, that one of the big x-rays that I am a fan of in the shoulder is something called a grassy view. There is the standard AP, external rotation, and AP internal rotation, but a few that I like to do is I like to rotate my patient 30 degrees, so the scapula is flat against the Bucky. Then I would shoot directly into the glenohumeral joint, and which is called a grassy sheet. Where the grassy, we should see the glenohumeral joint space very nicely. I can see that this is a well-done grassy, there is a nice flat line for the glenoid. But there is an overlap between the humeral head and the glenoid lens because this person has a posterior dislocation, and with that fixation and internal rotation, that is great. Something called the light bulb sign.

The other option you can do is if you are really not sure as humeral head where it is supposed to be doing scapular Y, and looking at the scapular Y, you can see is their displacement of the head. Not surprisingly, in a posterior dislocation, we can get similar fractures with the anterior dislocation, the reverse Hill-Sachs, and the reverse Bankart. Same thing just on the opposite sides, and of course, labrum pathology.

Presentation placement: 34:22

Now, we really cannot talk about the shoulder unless we also talk about labrum path. When we start looking at labrum injuries, label injuries are very common, and anybody who's got a history of shoulder dislocation. They are also very common and anybody who's doing overhead activities. When you are serving in tennis, when you are pitching in baseball, any of the throwing sports really can damage the labrum. In baseball, there is even a question of, can you even really be a good pitcher if you do not have a little labrum tear? When we look at the Labrum, this fiber cartilaginous ring lines the glenoid. Well, we

cannot see fiber cartilage when we are looking at an x-ray. If I have any concerns about labrum pathology, I always go to an MRI arthrogram.

Now, what kinds of things make me suspect it? the instability that if the person has any kind of feeling of instability, I am going to be worried about the labrum. If I get somebody who is an overhead sports activity, I am also going to be worried about the labrum and I would think about getting an arthrogram. It is those overhead activities, again, baseball pitchers, we see it in cricket, tennis and Swimmers. With the arm going over the head, painters are notorious for this type of injury and from my world of mechanics, spending a lot of time working over their heads, we look at tears like the labrum. There is a whole bunch of different types of labrum tears. We are going to focus on the most common type called slap tears superior labrum anterior to posterior. With slap tears, there are four major kinds of slap tears, and there is a total of 12 SLAP tears from that. So there are 12 SLAP tears. Types 5 through 12, are academics who are really trying to find something to publish. They are almost all variants of the first four types of SLAP tears.

With four types of SLAP tears, they are categorized as type 1, type 2, type 3, and type 4.

Type 1, this one's more age-related than anything else with a type 1 SLAP tear. If we think about the glenoid labrum as a ring, and it is got a triangular cross-section to it, then the free margin tends to fray and I am going to show you some schematics here in a little bit. Type 2, this person tears the labrum away from the glenoid, and in doing so, they also ablest the long head biceps anchor, because the long head biceps anchor is very intimately involved with the superior portion of labrum. The type 3 injury is just a bucket handle tear of the labrum but the long head biceps is intact, and then the tight for another bucket handle. But this one splits the biceps tendon.

Schematic for what a normal labrum should look like, we do not use the sagittal that much, I am just giving you the sagittal for representation. When we are talking about superior labrum we see this best on the coronal sequence and glenoid labrum and long head biceps tendon. If you look at this free margin right here, because it is a triangular cross-section, type one is afraid of that free margin. It starts to become indistinct, and this is super subtle, and it takes a lot of time to be able to really evaluate this. The clinical significance of type 1 SLAP is really highly questions can have great pain can it create instability, absolutely. But not to be thought of as likely as with the other types of injuries.

The Type 2 SLAP tear. This is a bucket handle tear, you can see where the labrum is detached along the superior portion of the glenoid, and then there is the labrum there is the long head biceps anchor, and the biceps anchor is no longer attached to the glenoid. That is exactly what we are seeing here, the long head biceps tendon is coming across, and the anchor would be right through there. Here is the triangle for the labrum, and notice that there is this nice line that is going through both of those separating out the labrum and the long head biceps anchor.

Type 3, the long head biceps anchor stays in place. But then the labrum is going to a vault in a bucket handle style. Here is the horizontal component of the long head biceps poking into the superior portion of the labrum or the glenoid rather, and then there is the small triangle for the labrum with a defect through there. Again, these are much easier to visualize and we are looking at arthrograms. The type 4 we see tearing through the labrum and then a longitudinal splitting of the long head biceps tendon. That is what is going on here long head biceps labrum tear goes up, and then there is a longitudinal splitting of that long head biceps tendon. This is sometimes thought to be looking somewhat analogous to an Oreo cookie, where you have got the two chocolate wafers and then the vanilla cream in between. I know shocker, radiologists using food analogies for things.

Presentation Placement 39:58

Now one of the other things we are worried about is when we find patients that have labrum pathology, and the labrum path itself is enough of a problem. But one of the other things that can happen is a phenomenon called a para labrum to assist. This is where the synovial fluid will force its way through that

tear, and it will create a cystic lesion outside of the glenohumeral joint capsule. This can happen anywhere along the course of the labrum. The big concern when we are dealing with slap tears is that they can get into an area where there is a nerve, okay? Because if this does tend to go superior or superior little posterior, the two big structures we are worried about are the suprascapular notch and the spinal glenoid notch. Because the suprascapular nerve runs through both of those and if the parallel cyst is in the suprascapular, Notch, this can deactivate the supraspinatus and Infraspinatus. If it is in the spinoglenoid notch can denervate, just the infraspinatus. This is one where we would want to evaluate very carefully as we are looking at that MR.

We are looking at the axial view on this particular shoulder, and as we come down, again, not the highest quality MR, but we can still see what we need to see. One of the things we notice is on this posterior aspect, there is a large fluid-filled cystic structure. One of the things that I can know because this is a non-contrast shoulder, they didn't put an arthrogram on this one. If I see this cystic structure, I know this person's got a labrum tear. That is how para-label cysts form. Whether I see it or not, I know that there is a labrum tear.

Because I see this large cyst, and it is right in the area of the spinal glenoid notch, I am going to want to look at the sagittal obliques. When I look at the sagittal obliques, so starting out, so here are the humerus fronts over here and backs over here. As we are scrolling backward, we can see the AC joint. One of the things I am noticing as I am looking at this is there is the supraspinatus as there is a subscapularis, look at the infraspinatus. Notice how the infraspinatus is a much lighter shade of grey than the supraspinatus or the teres minor. That is because this person has acute denervation of that infamous bananas. This large parallel cyst is compressing the suprascapular nerve in the spinal glenoid notch, and it is knocked out the infraspinatus. If this does not get decompressed in a short period of time, this person might be left with a permanent deficit in their infraspinatus.

Presentation Placement: 43:13
Another thing that we can see when we start looking at the shoulders, is pain with a reduction. Is that a Supraspinatus problem? Is that a sub-deltoid subacromial bursa problem? What is it going to look like on x-ray, generally we do not see it? I would take the x-ray to see if there is HADD in the area. But not surprisingly, when we start looking at this, we can see a really nice example of some sub-deltoid subacromial bursitis here. A nice fluid collection that the supraspinatus tendon itself is in good shape. That of course does bring us to the topic of tendinosis. When we start talking about shoulder issues, tendinosis is the big one. We do not use the word tendinitis anymore. Tendinitis implies an inflammatory response. It is a better term to use tendinosis or tendinopathy. When we start looking at tendon pathology, one of the things about tendon pathology is tendinosis happens, sometimes the tendon gets thicker, and sometimes it gets a little thinner. Sometimes you will see some irregular signal inside the tendon from an MRI perspective because we cannot see tendinosis when we look at an x-ray, something that can be very well documented using ultrasound as well.

There is a problem, and one of the problems with MRI is that when we are looking at MR when something is ballparked, around 55 degrees off the long axis, it can create some false high signal on T1s and proton densities, which is where one of those is the pulse sequences that we will use for evaluating tendons and ligaments. That is where we will always compare against the fluid-sensitive sequence like a T2 or a fat surprised to see if it is real or not.

Other things that go wrong with tendons are tenosynovitis, so we can see fluid collections in the synovial sheath surrounding the tendon. That of course is a very common theology. I used an angle here because looking at the tibialis posterior, and flexor helices we get that really nice appearance for the tenosynovitis. Shoulder we do not see tenosynovitis as commonly because there is no synovial sheath for the rotator cuff tendons. We can see it in the long head biceps tendon as it is down in the bicipital groove.

Other things we will see, are tendon tears. If you have looked at MR reports, one of the things you will see is sometimes it seems like there is a conflict, because you will read a report that says there is a full-thickness incomplete tear, and that just does not seem like it makes a lot of sense. Well, when we start

looking at tendon tears, there are a couple of different things to keep in mind. It is possible for the tendon to tear longitudinal, and it is called a delaminating tear. Then we talked about completeness and thickness.

One of the things to realize about almost every tendon, tendons are generally not round, tendons are flat. Because they have some flattening to them, will have a longer axis and a shorter axis. The shorter axis is where we talked about thickness, the longer axis is where we talked about completeness. Now a nice example of the longitudinal delamination that is happening through that region, is picked on an Achilles tendon because it is a nice big tendon. This thickness and completeness thing. Tendons are usually flat, they are not usually perfectly round. They have a short axis, and they have a long axis. The short axis is where we talked about thickness, the long axis is where we talked about completeness.

I like to usually start this explanation by looking at the full thickness, and incomplete tear. Here, we are looking sagely and we are looking along with you, we have the rope, and we are looking along the rope from the side. Here, we are looking down the axis of the rope. If I think about this, as my pen here is a tendon, this is the longitudinal look, and then this is the tangential look. If I drive a nail through a tendon, that nail will go all the way through the tendon from top to bottom, but it won't split it completely from front to back. Because it is going all the way through that short axis, that is a full thickness. But it is not going all the way front to back in a complete tear. The partial thickness is complete, this is where using a rope as an analogy, if I am taking a knife and I am sawing through a rope, I can saw through it all the way from front to back, and I am getting it partially through. It is a partial thickness it is not all the way on the short axis, but it is all the way on the long axis. So that is complete. A little nick in the tendon is a partial thickness incomplete. And then a full-thickness complete, usually, rather than using the term full-thickness complete, we just say rupture. Let us look at a couple of these on MR to see what they look like.

As I pull up the MRI for this case, I am in the coronal plane. So we are in that frontal plane, we are starting in the front, here is the coracoid, and as we go back, so here is the long head biceps right through here. You see there is some fluid surrounding now and now we are into the area of the supraspinatus standard. Now one of the things I noticed there are tendons are generally supposed to be fairly dark black on MRI, but I noticed as I am looking at this tendon, it is nice and dark black here, but then it starts to become a light, irregular grey, and it is never homogenous in any one shade of grey. There is a lot of streaking and stranding going on through there. A beautiful example of tendinosis. This person has supraspinatus tendinosis, and what are they clinically going to be presenting with probably an impingement style presentation, this person does have that downward-sloping acromion. Because that patient does not have any focal defects, I am not going to call any tears, I am just going to call tendinosis.

For our next patient, I am going to be on the T2 coronal and as I find my coracoid, I know I am starting in the front person has quite a bit of fluid in the bicipital groove, and as I am looking at their supraspinatus tendon, so right here, we are seeing Supraspinous there is a focal defect. So this person has a really nice focal defect. It is on the articular surface. Okay, and then I keep coming through. So, and there is a question on this one, is it actually going all the way through as we are seeing just a hint of fiber there? Could this be a full thickness all the way through? Could this be a partial-thickness involving 80% But it is definitely incomplete because the supraspinatus tendon is starting here? As I am going back the rest of the time That looks good. This person does also happen to have a little sub subacromial slash sub deltoid bursitis.

Coming into the coronal on this one. let us find our front. Here is the core code. We are coming into the supraspinatus tenant. One thing to realize is when we see start to see these little signal changes in the greater tuberosity usually is a good indicator that somebody has some chronic Supraspinous issues. As I am coming in, I am in the tendon, I can see the inferior portion coming all the way across, the superior portion stops, there is a gap, and then it comes through. But it is not all the way in the front. The anterior portion is intact, so this is a partial thickness, incomplete bursal surface tear. Coming into our last patient for rotator cuff pathology, we are on the coronal and I am going to start at the coracoid. As we scroll back, one of the important things to notice is, where is the supraspinatus tendon? I never see it. This person, the humerus is actually articulating with their chromium. This person has a rupture of the supraspinatus tendon with complete retraction.

The question is, how long has it been there? As we look at the sagittal, on this patient, I am going to start off on the humerus, and coracoid on the front side, notice that the supraspinatus has no muscle belly, and there is complete fatty atrophy of this person's Supraspinatus. We are seeing the same thing on their infraspinatus and on their subscapularis. This person has ruptured three of their four rotator cuff tendons. Teres minor is still intact and this person is why they are still a nice teres minor muscle belly.

Presentation Placement: 52:47
Other things that will be going on in the shoulder. There is an anomaly that can be implicated, so we have a person who's got, they are doing any of their shoulders, really shoulder-based style events. Racket sports, throwing sports, things of that nature. Well, when we get the person who has pain with AB duction, shoulder impingement rotator cuff tear, I realized that there is an anomaly that predisposes towards impingement. That is something called the Os Acromiale, so this is an opinionated secondary ossification center for the acromion between the scapula and the spine of the scapula and the acromion. The problem here is one of the theories behind how this works is this little junction here is fibrocartilage. As this person's AB ducts, the deltoid will actually pull down the acromion, instead of here is my acromion. Here is my deltoid. When my deltoid contracts, my arm comes up, and the acromion has a rigid surface. But in this patient, my MCPs, you are going to act like a joint, so as my deltoid can track, it actually pulls that Os Acromiale down to where it can dig into the supraspinatus tendon.

This can be difficult to see on a standard shoulder series, on a standard AP internal rotation, or on external rotation. That is where a scapular wide view can be really useful for a patient like this if I am concerned about it. We can also see it nicely on MR. Just to show you so clavicle acromion, and here is what an Os Acromiale looks like. You can actually see that fibrocartilaginous junction there. If you do have a patient that has chronic impingement, and they have an Os Acromiale, this is a relatively easy orthopedic fix, the orthopedist will drive a screw through the posterior aspect of the acromion and tighten everything up so that it does not have that flexibility.

Something else that is on our list of differentials for a patient that has shoulder pain, whether traumatically induced or chronic long-term is hydroxyapatite deposition disease, and we know that most of the things we see in the shoulder are going to be tendinosis that we will treat conservatively, without even having to get advanced imaging. However, I am pretty liberal about x-ray and shoulders because there are a lot of things that can go onto the shoulders that we can see radiographically and one of those adds hydroxyapatite deposition disease. Technically, realistically, the term for this is technically calcium hydroxyapatite deposition disease. So realistically, this disease should be called CHADD. I am pretty happy that we have dropped the C off of this one so that this is called HADD because I am not really happy about diseases being called CHADD.

Very common to see this in the rotator cuff. It is actually the most common place in the human body to see HADD in the rotator cuff. As we start to look at it, and it is a very characteristic appearance, it is not a difficult thing to call. When I started looking at the shoulder x-ray, I can see that there is a really nice example of calcium in the supraspinatus. I know it is in the supraspinatus because when I compare the external rotation view, with the internal rotation view, I am looking at the greater tuberosity, the first centimeter of the greater tuberosity is the supraspinatus, the second centimeters infraspinatus, and the third centimeter is teres minor. It is pretty easy to figure out which of the tendons is involved when I am looking at a case of HADD. The other thing is how we can see this on advanced imaging, it shows up on MR, and it shows up on ultrasound. In this particular case, I am on the axial. As I scroll down on the axial, I can see that right there in the infraspinatus tendon, there is a huge blob of low signal intensity calcium. This person has HADD of the infraspinatus tendon. This could also involve the bursa we can see this on the subacromial/subdeltoid bursa very commonly.

What about the long head, biceps tendon, and the long head biceps tendon is another one that can very commonly be injured, we can see tendinosis in the long head biceps, and we can see it a vols when we are looking at a slap too, we can see a longitudinal tearing with a slap for. So those are possibilities. One of the other big possibilities is again, I get somebody who does a lot of internal-external rotation as part of their event. We can start to see where I get this snapping in my shoulder every time I internally and

externally rotate. Worried about this person having a person having dislocation of the biceps tendon looking at that long head biceps tendon for dislocation.

When I want to evaluate that, we do the orthopedic tests, one of the things that are really interesting to think about is when we look at the long head, the biceps tendon can actually dislocate in two possible directions. It can dislocate superior to the super spear, the subscapularis, if the transverse humeral ligament tears, or it can dislocate deep to the subscapularis if the subscapularis insertion is where the terrorists so pull up our study here.

Now to evaluate, when we start looking at evaluating the biceps tendon, the best way to do the horizontal component we see on the coronal and on the sagittal is, is if I pull this coronal over. Okay, find the coracoid. There, we are in the front, and the long head biceps tendon is going to be coming across here where the biceps anchor is, and to evaluate the vertical component, we use the axial. We are starting at the top and working our way down. As we do, we can see the humerus and there is the bicipital groove. Not surprisingly, the long head and biceps tendon should be located inside the bicipital groove, and in this patient, here is the long head, and biceps tendon, and it never comes anywhere near that groove. What is interesting though, is it is when I follow that tendon, so follow this to here where it is starting to turn and coming over this way. This one is actually deep to the subscapularis tendon. So subscapularis is here, and then the long head, the biceps tendon is here. A good thing to keep in mind.

When we start thinking about the transverse humeral ligament, the subscapularis, actually, if you look histologically, and there is been some interesting anatomic studies, the subscapularis as it comes across, inserts onto the lesser tubercle and onto the floor of the bicipital groove. But it also contributes fibers that make up the transverse humeral ligament. So that is where subscapularis pathology can quite often be intimately related to long head biceps subluxation dislocation, so if this person were to damage the transverse humeral ligament, then that long head biceps tendon will be in front of the subscapularis. But in this case the long head biceps are deep to the subscapular. This person had a partial subscapularis tear at the insertion that let the tendon dislocate deep to the sub scab.

So, those are our various shoulder pathologies, and not surprisingly spent the entire hour on the shoulder because the shoulder is one of the most complicated joints in the body. When we come back as we start getting into Upper Extremity Trauma 2, we are going to focus on the elbow, hand, and wrist, well, all complicated in their very own rights, usually a little bit more straightforward than some of the shoulder pathologies.

Thank you very much for following this lecturer. I will see you back for Upper Extremity Injuries 2

[END]