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ICSC Lower Extremity Module 5

Section 2.1_ICSC05

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Video Lesson: 54:00

Welcome to Assessment of the Knee. Today we are going to be looking into how we assess the knee on and off the field, some treatment strategies for the knee, and then just really trying to kind of wrap your brain around how we might look at a knee differently in different populations. I hope you enjoy this lecture, as much as I enjoy giving it. The knee is one of my favorite lectures, so, hopefully, we will have some fun with it.

Let us just take a quick minute and do a little review of the anatomy of the knee. Since we are going to be talking a lot about the anatomical structures today, it is worth us just taking a minute, stepping back, and appreciating not only the anatomy, but the mechanics of the knee. We always describe the knee as this simple hinge joint, but really, the knee does not only flex, but it also flexes and rotates. As it flexes, it kind of pivots on that medial aspect of the inside aspect here. This is why we see more medial injury, why more posterior horn of the medial meniscus tears, is that instead of that simple flexion that we kind of learned on how the knee flexes, it flexes and kind of rotates on itself a little bit as our foot pronates when we are walking. So, really appreciating what structures can get affected with which mechanics.

We are going to kind of start looking at simple vectors of force that cause injury, and then we are going to tier that out to multivectors of force or fault lines, what I call, looking at a whole pattern of events that might cause an injury. But first, we have got to figure out how to laser focus your diagnosis for each particular structure. Let us begin with that.

Today, we are going to look at the evaluation, diagnosis, the treatment plan, and also the return to sport plan for the knee. Objectives for today are discussion of and looking at the anatomical structures, the mechanism of injuries, our evaluation protocols, injury assessment skills. Very important. I want you to really take those and practice those when we are done with the lecture today and kind of keep doing them over and over, so you get a feel of what normal and abnormal feels like. Functional mechanics in injury, physiotherapy protocols for the knee, and then the return sport plan. So, lots of things going on.

Let us start with the medial knee or the inside of the knee, which is the most injured structure in the side of the knee. We will look at why just a little further on. If we look at the graphic on the left side of the screen here, this is your medial collateral ligament. We think about which vectors of force cause a medial collateral ligament injury, and it would be a valgus force. The test we do for that is your valgus stress test. It makes perfect sense. Valgus force would be if somebody hits you from the outside, and this ligament stretched on the inside. So, understand it is kind of like that bow and arrow, where we hit on one side, and it stretches on the outside. Then this ligament on the outside would be the injured ligament. That is your medial collateral ligament.

Also appreciating the anatomy here on your medial side. This is the medial patellar retinaculum. This helps form that kind of capsule of the knee. It is an investment, like an aponeurosis of the vastus medialis muscle as it comes down. When you are near assessing a knee injury, we think about the major structure that is injured. But I want you to appreciate the other anatomy in the area that probably is also affected. We would be kidding ourselves to think that if a valgus force came in, and we got hit enough to tear this ligament, that nothing has happened to any other structure. So, this is why in this lesson, we are going to really teach you to do a full evaluation on each injury, and that way we do not miss anything. You know, you got hit from the outside, it is only a medial collateral ligament and that is it. I think we are kidding ourselves to think that. There are other structures here that we also need to look at. We therefore need to do a nice, complete evaluation on everybody.

Then if we also peel off this top layer here and get rid of this medial collateral ligament, we are left with this, which is your medial patellofemoral ligament. This is a ligament that when it is torn, you get a patellar dislocation. You can have a partial tear where it stretches, and your patella moves slightly laterally. In that instance, we can rehab that conservatively. But in the instance of a complete rupture, that becomes a surgical case. This ligament

here is kind of like the check strap that holds this patella in place, right in the midline of the knee. We can track superior and inferior with quad contraction in that trochlear groove under it.

If we look at the lateral side of the knee, conversely, we can understand that the lateral collateral ligament, which is this little ligament here. There is also an anterior lateral collateral ligament, which is this little branch here, which we do not hear a lot about. But the new literature is coming out with some interesting facts on this anterior branch. Let us just put that to the side for a minute and let us just talk about the lateral collateral ligament, which is here, or fibular collateral ligament, depending on which nomenclature you learned. This would prevent a varus stress to the knee. In other words, if we got hit on the inside of the knee, and it bowed out on the outside and tore, a varus stress would cause that. A varus stress test would be an orthopedic test for that.

Again, here is the lateral patellar retinaculum or the patella. It is kind of that aponeurosis that is formed from the vastus lateralis muscle as it comes down and inserts on. Again, speaking to the fact that we really need to appreciate that there is lots of structures that are kind of affected with a knee injury. We really need to make sure that we are doing a good job at looking at all the structures that get injured in the area, and not just the one structure, the lateral collateral, because you see how tiny that is compared to this patellar retinaculum. So maybe some of this is injured as well. I want you to make sure you really grab that concept that we are going to be looking at all the structures. This anterior branch of the lateral collateral ligament is quite interesting. Now, as I said in some of the newer literature, it is really speaking to the fact that it helps prevent anterior translation of the tibia. So that means the tibia sliding forward on the femur. When that is intact and tight, we have some assistance in preventing ACL tears. That is anterior cruciate ligament tears. We are going to look for that in the literature as it is coming out with some new kind of enlightened facts that we might not need to do a reconstruction of the anterior cruciate ligament if this is holding that tibia in place.

Then just appreciating the medial collateral ligaments from the anterior to posterior view here and understanding it, you know, the length of this medial collateral ligament, which is really known for scarring quite significantly. It is a wide band ligament and fibrous. When you get an injury to the medial collateral ligament, it is quite interesting. It loves to scar over. So really making sure that you are staying on top of keeping them keeping an eye on the status of the healing. I like to put an arch support in the shoe while we are healing with this injury so that the patient can have a little lift on the medial component. It does not pronate as much, therefore they do not stretch the medial collateral ligament. Scraping of this ligament during rehabilitation is important to making sure we are checking that scar tissue does not form. Scar tissue of the medial collateral ligament becomes more painful than the injury itself, and causes what we call prodromal injury or a long-lasting injury that limits them for a very, very long period of time.

I had an athlete that came in that had been able to participate in sports or run for one year and she was only seventeen. She had had a medial collateral ligament injury and just not rehab properly, therefore, it formed a lot of scar tissue which became more painful than the injury itself. So just keeping an eye on that way. A little clinical pearl regarding that medial collateral ligament and its rehab.

Looking at the menisci, medial and lateral meniscus from the anterior to posterior view too. I want you to really appreciate this trochlear space. We will call it the trochlear groove of the knee. We will look at that for patellofemoral issues. And then the pencil thin and a little bit more fibrous lateral collateral ligament not injured as much as the medial collateral ligament.

The anterior cruciate ligament is very, very commonly injured more in females than males. There is lots of research as to why we are seeing this increased predisposition for ACL injury. We are going to talk about that as we go through our case studies today and having some fun with that. I want you to really appreciate where these this ACL is sitting in the knee here and its relationship to the cartilage and its relationship to kind of the check strap, as this ACL prevents the tibia here from sliding forward. As you plant, if this is your tibia, the ACL stops it from doing this. It is kind of that check strap from pulling it back.

We think about the ACL injuries. You can have a contact ACL injury. In other words, if somebody hits your knee, and it pops out or ruptures the ACL. Or you can have a non-contact ACL injury. The non-contact ACL injury is the ACL injury where your foot is planted, your knees flex to 20 to 30 degrees, and then you internally rotate on that

planted foot. That is the motion that the ACL is under the most tension, and we see rupture in a non-contact injury. These are the injuries that we are researching quite heavily right now because we want to figure out what are the mechanics involved that are predisposing somebody to that injury? If we think about that and we could really solve that puzzle, we can think about how to correct those mechanics in the preseason to prevent ACL injury. This is what we are going to talk about as we get further along. This is kind of one of my things that I love to do. I like to pre-screen athletes before the season, correct these biomechanical faults to avoid these types of injuries. That is something where I feel chiropractors can really jump in and be champions with, is that we have a good idea of movement of the body, and symmetry, and we can pick up the faults whether it is not only with the knee, but with the whole system, and we can correct these faults early on before an injury occurs.

We look at the left picture here of your ACL. That is normal. As compared to the right, that is a torn ACL. The ACL is called your anterior cruciate ligament, cruciate meaning cross. This is because it forms a cross between the posterior cruciate ligament and the anterior. That is why they are called cruciate. The posterior cruciate prevents the movement backwards, the tibia sliding backwards. The anterior prevents the tibia sliding forwards. They form that cross so they can check straps.

If we look at that posterior cruciate ligament here, we can really see it in green, how it comes back, and it forms that nice stable structure. Remember some of these slides you have seen in the biomechanics lecture that was just presented to you earlier. I wanted to just make sure that we went over it thoroughly because you really need to picture that anatomy as you are assessing. Understand what structure you are affecting. Thanks to Dr. Steve for giving us some of these previous slides to put into this program.

This is your posterior meniscal femoral ligament, not really talked about quite frequently. It attaches from the meniscus, the posterior horn here of the meniscus, into the femur for stability. And then here is your medial meniscus. And really understanding how that medial meniscus forms kind of that little shock absorption between your femur and your tibia. When we look at that posterior cruciate, we are going to be looking for a posterior sag sign. We are going to talk more about these orthopaedic tests as we get further on. We will demonstrate them to you. We will show you a full knee exam. That way, by the time you are done with this class, you are really going to feel confident with the knee.

This articular cartilage is a very important part of the knee when we talk about patellofemoral issues. Patellofemoral mal tracking, patellofemoral pain is the most common pain of all injuries, athlete and non. It is the most common complaint. If there is one injury or one pathomechanic fault that you really need to comprehend, it would be understanding this patellofemoral mechanism. What happens is when the patella does not track in this trochlear groove appropriately, it starts bumping up against these femoral condyles here, and then it starts wearing away this articular cartilage. But why that is significant is you might not feel pain until this articular cartilage is severely worn down and we get down to the subchondral bone. By the time they are having pain, they have already gone down the road of mal tracking for a long period of time. You need to unpeel those years of mal tracking in your rehabilitation concept. We will talk about that again as we get further along.

Here is that posterior and anterior cruciate. I said it formed a cross. There is a better look at that cross. And then your medial meniscus, how it forms a large shape C, and then that lateral meniscus is almost like an O shape.

The axial view here, again, is looking down at the knee. I want you to appreciate the medial meniscus here, the posterior horn of the medial meniscus, and the lateral meniscus. Also, in this view, we really can get a good idea of this medial collateral ligament from an axial view and the lateral collateral ligament. This is your patellar tendon, anterior cruciate, posterior cruciate, and your fibula.

Look at this wide space here of non-protected area. You can imagine with a valgus stress, in other words, someone gets hit on the outside of the knee while running or tackled here. That can cause a varus stress quite easily to this part of the knee. Therefore, we probably see more medial knee injuries than lateral. It is just a little more unprotected area on the medial side of the knee.

Again, looking at that superior view. We talked about the menisci as having white zones and red zones. Red zones are the areas that have high proliferation, a lot of blood flow, and they heal easier. When we see an injury to the white zone of the meniscus, the healing takes a longer time and sometimes does not occur to that area. Those types of injuries would be a referral to an ortho if we see a significant tear in the white zone. We can see we have a red zone here with good blood infiltration, and then kind of a medium healing capacity here. And then your lowest healing capacity would be these white zones.

The most frequently torn is the posterior medial aspect. Posterior horn of the medial meniscus is your most frequently torn meniscus here. Sometimes we get what we call bucket handle tears, and that is a tear where you get a tear of this posterior horn, it flips up and gets stuck in the joint capsule. When that happens, the patient's knee will get stuck. Then we will have to kind of jiggle it and then we will be able to straighten it. That is a typical what we call a bucket handle tear. You can also get a bucket handle tear for the lateral meniscus, posterior horn. Those most times become surgical. Whenever we see getting stuck or a locking of the knee, we have got to go in and clean out that tear.

Here is just a different view of the medial lateral meniscus of the knee here. Understanding here is the lateral meniscus, and we talked about that posterior meniscus femoral ligament kind of holding that in place, and the medial meniscus here. The ortho tests that we use for those are McMurray's test, Thessaly's test and Apley's test. I will tell you that Thessaly's test is the most sensitive for meniscal injury. We will go over how to do that in a little while. McMurray's test is also very good. But if we look at the literature for meniscal testing, we know that not no one test singly is the best test. We really need to have a good thorough history. We need to have a mechanism of injury. We need to understand past injuries. And then we also need to include our whole exam. That way, we can get a really laser-focused diagnosis.

If we move out to our muscular layer of the knee, we can understand this whole idea that it is unlikely that we just get one pure injury. Like, a medial collateral ligament. We have got to really know that there are layers of anatomy here. When we evaluate somebody, I want you to think about those layers and how they could be injured in that mechanism of injury or the way that that athlete was injured. So, if we just appreciate the quadriceps complex here and our whole attachment of our adductor group here, Sartorius, Gracilis, and Semitendinosus, which is hamstring, and then your iliotibial band as it divests down into a little portion that goes off to that patellar retinaculum, and then down to Grey's tubercle, where it attaches. We need to make sure that we are looking at everything when we look at a knee, is my point, with these muscular layers.

Here is the medial muscular layer here and understanding that this green structure is your medial collateral ligament. So, with an abrupt valgus stress to the knee where we injure this medial collateral ligament, we must understand that there is some injury to the structures that are superficial to it. It would make sense. This is your Sartorius, Gracilis, and Semitendinosus here right in a row, and then this is Semimembranosus back here. Do not forget to look at that medial hamstring complex. Also, assess that when you are assessing a knee injury. I think that a lot of times that is often forgotten.

Then if we look at that muscular layer of the lateral aspect of the knee, again, here is your iliotibial band and tract as it divests down into the joint capsule to attach on to the lateral aspect of the tibia. And then your foot extensor group here, your anterior tibialis and then your lateral collateral ligament, the anterior branch. And then we must also understand that we have your biceps femoris. Here that is coming right over that lateral collateral ligament. Making sure we are evaluating those hamstrings. This is your extensor digitorum group here and anterior tibialis. Extensor digitorum, anterior tibialis, bicep stim, IT band. Make sure you are assessing all those also when you are assessing the knee.

This patellofemoral articulation from just a different view. Understanding and appreciating this trochlear groove here, and how that shape of the patella, see the shape of the patella, is designed to slide in that trochlear groove and go superior and inferior with quadriceps contraction. I tell my patients it functions like a monorail. It is got to glide in and out. Appreciating that when we have weakness of the vastus medialis muscle, this patella is going to start tracking laterally. And when that patella starts tracking laterally, that you get this inferior aspect of the patella hitting up against this lateral femoral condyle. Understand the lateral femoral condyle in most patients is

larger than the medial femoral condyle. So, with that very strong quadricep group pulling laterally, and most times the vastus medialis muscle, the VMO muscle, not as strong as those, we get that Patellofemoral Mal tracking Syndrome. It used to be called chondromalacia a long time ago. Now we call it patellofemoral mal tracking more appropriately. This is what wears down this subchondral bone that we talked about earlier.

Our job is to kind of get this patella realigned with rehabilitation, different types of scraping and taping protocols, to try to get that patellar to drop back into the trochlear groove and adequately train that vastus medialis muscle. So really thinking about what fault patterns of our long mechanism can contribute to a weakened vastus medialis muscle.

Here is another look. It is my favourite look. The sunrise view of the patellofemoral articulation. I use this view a lot to kind of assess the status of that patellofemoral joint with somebody who has kind of like peripatellar pain. If you look at the picture on the left side, you can see that we do not have symmetry of this patellar in the trochlear groove. It is tracking quite laterally here. We are going to get what I call a kissing injury where it is kind of rubbing up against this lateral femoral condyle. You can appreciate in that picture that we can almost see a little spur forming on this lateral side, and that is that tracking spur from the strength of those muscles and the capsular pattern pulling on the lateral aspect of that patella. So, that becomes quite painful.

The picture on the right is a status post-surgical partial knee reconstruction of a recent patient of mine. During the partial knee reconstruction, they cut his medial patellofemoral ligament by accident. Therefore, it is an unsuccessful surgery. So, we do not have patellofemoral tracking. He still had the same pain he had prior to his surgery here. We did not fix the problem. This is an iatrogenic cause, which means doctor induced. I was doing his rehab. It was during COVID. He was coming in for me to do some rehab on his knee, and I noticed that his scar was just sitting more medial than most scars and I assessed him. I said, "I am pretty sure they slashed your medial patellofemoral ligament here." When we did the sunrise view, yeah, that is not even a little attached. He had to go in and have a surgical repair to reconstruct this medial patellofemoral ligament. So just keeping an eye out for that can also tell us how we want to tape or how we want to treat them. We can do, and we will go over a little bit later, a McConnell taping to help pull this back over. That is a successful technique to use if looking at patellofemoral issues.

We talked a little bit about the iliotibial band. Understand that it has a relationship to the knee, and that you will get lateral knee pain when you have a tight IT band. When you are evaluating a knee, do not hesitate to evaluate the hip also and the foot, because we have got to really understand how to laser focus our diagnosis, and then how to open that diagnosis up to look at the surrounding joints, so we can see if there are contributing factors. Why did this injury happen? Or why does this injury not get better? Looking at that whole mechanism of injury and that faulty pelvic alignment. Is there a pelvic alignment issue? Then we need to look at footwear, very important, particularly for the iliotibial band. If we have excessive pronation, we are going to have an iliotibial band problem for sure.

Looking at the terrain. We will have iliotibial band injuries if the runner is always running on the same side of the road. Here in the States, the roads are kind of what we call a cambered surface, which means it is kind of home like this, so that when it rains, the rainwater trickles to the side. If we have runners that are always running on one side of the road, what that means is that one leg is longer and one leg is shorter all the time, and they develop this tibial band syndrome. We try to get them to run on a flat surface or if they are running on a Cambridge surface, to run out on one side and run back on the same side, not switch sides of the road. That way different legs are short and long in the same run to kind of even it out. That is helpful.

I want you to look at the structure, the function, the biomechanics of the joints, above and below, how it relates to the low back and the pelvic alignment. Do not forget to look at the foot and the ankle and the shoes. For now, we are going to start with just trying to laser focus a diagnosis, and then later on in the lecture, we are going to open up to how to kind of look at the biomechanical faults in somebody.

We will go back to how to assess a sprain. This is an example of ankle sprain, but it can be applied to any ligament. If we look at normal ligament architecture, it is kind of a nice vertical pattern here. A grade 1 might be

some stretching and some small tears in the substance. A grade 2 would be a larger tear, and a grade 3 might be a rupture.

Remembering that the grade will also kind of be depicted by the amount of inflammation and the amount of joint gapping that we see with orthopedic examination. We are going to talk a little more about that as we get into the ortho evaluations. We can kind of appreciate that this is not going to swell as much as this. We understand that. When you see a whole load of swelling in an area, know that you probably do not have a grade 1 sprain. A grade 1 will have very little swelling to it, and that is whether it applies to the ankle, the knee, the shoulder, the elbow, hand, wrist. So, really imagining the amount of tearing that happens with each one and which ligament is affected.

What I thought we would do is to kind of make this a full immersion type course. We are going to present a case study; we are going to work through the case study. I want you to stay invested in the topic and I want you to think about what you would do. Then we are going to present the whole case and work through a case to completion. We have several cases we are going to be going through today. Let us get started. Think about what's your first most important aspect of your patient encounter. When you are evaluating the injury, whether you are working on the field with a team or you are in your office, what is the component that is most important? Honestly, it is getting that mechanism of injury, the history of injury. If we think about what the biggest predictor of injury in the body is, the answer is always history of previous injury. Take those few minutes and really talk to your patient and figure out if they have had an old injury to this area or an old surgical repair that you need to consider when evaluating.

Let us talk about our first case. These are all real cases that are currently in my office, by the way. We are going to work through them together. A 17-year-old female reports with left knee pain and swelling. We think about things. First off, is there swelling there? There certainly is an injury, and if there is swelling, it is something that is newer. It is a 17-year-old female. We have to understand, am I looking at growth plates or not growth plates? Are growth plates closed? What's the tanner stage of this athlete? How are they in skeletal maturation? And what activities do they do?

We are going to look at the onset of symptoms, she said it happened while playing soccer, and she said she was running to get a ball, she pivoted on that leg to move quickly to the right. She's got left knee pain, she was planted on the left, she pivoted on that to go towards the right side. I want you to really imagine that mechanism of injury. She does not recall getting tackled or being near any players when it happened. She reports feeling a pop in the knee when she felt the pain. We have got to think about what structures are you thinking about already? What are you thinking about? She was planted on her left and she went to the right. If she is planted on the left and went to the right, then we are going to think about possibly medial knee injury. You should already be formulating these in your brain as you are hearing somebody's history and what they are telling you. We are going to ask these questions to grade the severity of injury. Like, were you able to continue playing? Did you ever have this injury before? Did you get much swelling? Were you able to walk off the field? Did somebody have to carry you off the field? Were they walking into your office? Did they have a limp? Did they need crutches? All these things give you an idea of severity.

Now we need to start gathering our facts. She has a history of ACL rupture and surgical repair roughly one year ago on the opposite side, on the right knee. She is injured her left now. She reports that she completed 9 months of rehab and was released to play. You really need to understand that the ACL is an interesting structure. She underwent a right ACL repair and reconstruction, and she did 9 months of rehab. That is a long rehab, and it is quite a rigorous rehab. It is a painful rehab in the beginning to get that range of motion back after they put the graft in.

The interesting thing about swelling tells us severity. Bruising also is very important. When we think of bruising and think of fracture sometimes or severe grade 3 if it bruises right away. Bruising the next day or two days later, this is going to happen with a sprain.

I want you to think about your plan of action. What would you do now with this athlete? 17 years old, left knee pain and swelling, happened while playing soccer yesterday. She hobbled into your office today in a lot of pain.

What is your evaluation protocol? Would it be this? Probably not. We want to think about when is it appropriate to do certain evaluation protocols and when it is not. It is not necessarily appropriate to do a whole functional evaluation on somebody that has an insufficient region. Whether it is ankle, knee, hip, shoulder elbow. We want to think about the appropriate evaluation at the appropriate time. We are not going to be doing functional movement assessment on that day with her.

That is her squatting. That is not that day. That was her squatting in her rehab before this injury. Before this injury, she was functioning quite nicely. Here she is again. Again, we talked about the left side. She had a right ACL injury. You can see on this squat; she is putting more weight on the right side. She feels a little more comfortable on that right, and that was that surgical repair. Can you see that little lean there to the right side?

We talked about that thinking about that mechanism of injury, formulating in your brain what structures you want to evaluate. We talked about the structures. Let us just keep moving forward. What are your thoughts? What is your plan of action? Here is her before this injury again, from the side view. We do tons of videos in my office. She had a nice squat, she had good mechanics. What we see for ACL is they go back too soon, and they go back with bad mechanics, but not the instance in her case.

What ortho tests do you want to include with this evaluate? What functional exam? We are not going to do a functional exam today. That is a trick question. What is your plan of action today for her?

This is a terrible picture right here. It is very important to talk about. This is on my Instagram post. On the importance of starting every knee exam with girth measurements, very important. We want to make sure that you are truly evaluating the knee. We are going to watch this little video of me doing girth measurements of the knee, and I think it is very important to include on all your initial knee exams.

We are going over why we do girth measurements for knee injury, in assessing a knee injury. If you think about the idea of taking girth measurements, it gives us an idea of the nature of the injury. Is it acute, is it sub-acute, or is it chronic? To do this, we take three locations of measurement. We take one intra-articularly and [inaudible] the joint lines. You are just going to find your joint line, and you are going to just take measurements, and you are going to compare these to the other side because we are looking for any edema. We are looking at size difference and girth measurement difference.

Then we are going to take it again, 3 and 6 inches suprapatellar. I have already marked out 3 and 6 inches on each of her quads here. Then I would take the tape measure. Just go ahead and check the girth measure on each side, 3 and 6 inches. Do the same thing here, comparing. Now understand, in the joint itself, I am looking for edema. I am going to look for it. This is larger than the other side. Up here, I am going to look for atrophy. The atrophy tells me a story about the knee. If there is atrophy 3 inches suprapatellar, that tells me there is an acute compensatory mechanism. The VMO is wasting on a shorter time span. If there is atrophy 6 inches, suprapatellar, long-term compensatory changes.

If I have swelling in a knee, and they have atrophy greater than an inch in the squat as compared to the other side, I am really looking for an acute-on-chronic problem. Because the 6 inches is long-term compensation, and if they have new edema, that tells me we have a new problem. Then in that instance, I would need to go back and look at my whole kinematic chain and my gait cycle to see how she's compensating that predisposed her to knee injury, or why does she have that long term compensatory change? Girth measurement really gives us a lot of information when we are assessing a knee. Consider implementing it into your exam.

As we move forward, very important component, I do this with every knee evaluation. You see the pen sitting in the middle. I have a pen and paper. I compare side to side, and I have my starting point. Then I will use this as my reference to come back to every 3 weeks or so just to see that we are improving and moving forward with kind of creating that harmony or the synchronicity or symmetry in the lower extremity.

Here is our exam procedure. We want to think about, for every extremity that you work on, what are my ticking points? What do I need to get done to get a good quality evaluation completed? MOI is mechanism of injury.

What are my predisposing factors? Footwear? Was the terrain wet? Was it raining that day or snowing? Was the athlete not warmed up? What are my functional examination assessments? Inspection and palpation, range of motion, manual muscle test, passive and active ranges of motion special tests, neurovascular imaging, and referral patterns. Or like who you want to refer to or who are your favourites to refer to. So, really thinking about how do I put this in a jar or a can? So that every time I evaluate somebody, I am making sure I am getting all these ticking points done, because this is how you need to think about an evaluation. You know, you need to take some time and talk to your athlete about the mechanism of injury, predisposing factors, history of previous injury.

Functional assessment may or may not be done depending on the severity of the injury or the chronicity. If it is an old problem, we can do a functional exam. But getting down to every evaluation, always begin with inspection and palpation, and then move into active range of motion first, manual muscle tests, passive range of motion, special testing, neurovascular imaging, and referrals. Kind of think about that cascade that needs to happen, and that way you do not forget anything. Do everything the same.

We are going to look at some pics of assessment. This is our active range of motion of the knee, and our range should get up to 135 in a healthy knee from 0 degrees, all the way to extension. Then we are going to look at our ortho testing. This is our valgus stress test. Valgus stress test tests the medial collateral ligament. I am assessing the medial collateral. We are going to do it at 0 degrees, which is here, and then we are going to do it again at 30 degrees. This is diagnostically accurate 86 to 96%, and sensitive at 30 degrees. You will see this is 0. When you are at 0 degrees, the knee is locked out. We are going to have a tighter joint capsule. What's going to happen is we are not going to get as much joint gapping when we are testing that knee. The more severe injuries are going to be seen at zero. When you get joint gapping or that joint opens at 0 degrees, know that it is probably a little more severe of an injury than if you get joint gapping at 30 degrees.

Here is our Varus Stress Test testing your lateral collateral ligament here, and this is a test at 0 degrees. Again, same thing, thinking about what structures could be injured here. That is a varus stress versus your valgus stress. Here is our valgus stress at 30 degrees. Again, we are going to get a more discreet tear or grade 1. We are going to see more at our 30 degrees. Then at 0, we are going to pick up those grades 2 and grade 3s for sure. Thinking about making sure you really have that knee locked out and you are not moving the whole hip; you are just moving the knee. We will show an example of this as we get further along. And then here is your varus stress at 30 degrees here.

Looking for joint gapping. Our meniscus tests. We are going to do McMurray's test and Thessaly's test. Thessaly's test is more sensitive than McMurray's test. McMurray's test is great for understanding the sensitivity the patient is feeling as you circumduct the knee and bring it down. You will see in the next picture here on the left, you form a circle. Put your fingers on the joint line, you command control of the foot here, really making sure you have a good quality, have that knee at a 90/90 here, and then you are forming a big circle with the knee, not just flexing it down. This is a circle. You will see as I will show a video of it a little later, but in this range is where they are going to feel the pain or not let you bring it down to this much flexion if there is a posterior meniscal tear. We are looking for our posterior horns here. So really going slowly and making sure that we have a good idea of facial expression when the knee is bent like this. If they are kind of getting a little nervous or it is painful, get that meniscus diagnosis in the back of your brain.

We move on to our ACL tests or anterior cruciate tests. This is our Lachman's test here. Again, we are going to be pulling the tibia, translating it anteriorly. You are just stabilizing that femur. You are holding the femur stable, and you are pulling that tibia anteriorly towards the ceiling just to see if you get any gliding, to see if that ACL is insufficient. Our ACL tests are Lachman's, anterior drawer and pivot shift. This is a Lachman's test. This is your anterior drawer test for ACL. If you notice that I am kneeling on the foot. I will kneel or sit on the foot because you do not want the foot to slide. Your fingers go to the joint line and drop down right onto the tibial plafond or plateau. Then you are pulling like you are opening a drawer. You are pulling that tibia out towards you to try to see how much gapping you get here. You are going to feel a clunk when you do it if the ACL is torn, but you are also going to see a lot of movement and anterior translation here.

Really understanding when you are doing orthopedic tests, though, that you are doing them bilaterally, and always start first on the uninjured side. It gives you an idea of ligament laxity in the patient first, and it also gains their trust in you. So always start with that healthy side, go through your orthopedic tests, then go over to the injured side and do your orthopedic tests. Number one, the patient is going to know what to expect, and there is not going to be so much guarding, and number two, you will have an idea of their status, ligament laxity-wise, so you know what normal and abnormal is. It is a very important part.

This is a good example of a posterior sag sign. We can see that the posterior cruciate ligament is torn, and it drops posteriorly. You can really get an idea of a function of that posterior cruciate, that we have this drop off point here in the knee, and that would be a posterior sag test or posterior sag sign.

Let us go back to our case study now that we ran through our orthopedic tests here, and we are going to see what our findings are in our ACL. She had a +1 inch plus edema around the midpoint of the left knee. She had good symmetry, a quarter an inch at both 3 and 6 inches, suprapatellar, compared bilaterally. We say within a quarter of an inch; it is decent symmetry. She has 1 inch of edema around the joint line. I know it is a new injury. Intra-articular swelling. When we think of intra-articular swelling, we think of two things that swell the joint the most in acute injury, and that is the ACL and meniscus. When you have a lot of swelling, think of those two structures, and then she has good symmetry. She rehabbed her old ACL pretty good because she does not have that 1-inch greater deficit at 6 inches on the opposite side. We have no long-term issues here, even though she has that history of ACL.

Medial joint line tenderness. If I am thinking about medial joint line tenderness, I can think of meniscus or medial collateral ligament pain with valgus stress at 30 degrees. It does not say zero degrees. 30 degrees are more discreet, medial collateral ligament injury. Negative varus stress, so lateral collateral ligament is in good shape. McMurray's is positive for pain and clicking at the joint line. Positive for what? Meniscus. Positive anterior drawer. Anterior drawer is for ACL. Negative posterior drawer, so PCL is intact.

After you have run your orthopedic tests and you have these findings, you should be able to come up with your differential diagnosis. You should have an idea of what you think is going on. Here is a look at her knee. We can see some edema even posteriorly. But that is an important picture, because most patients with a knee injury will come in and tell you that they have this pain in the back of their knee, and they are going to keep telling you about pain in the back of the knee, and that is, again, for mostly all knee injuries. But really understand that swelling goes where there is room to go. Thinking about the knee this pop fossa has a lot of room for your intra-articular edema to drop to. When we look at images, MRIs, we can see that that edema loves to sit in this posterior capsular area and the pop fossa.

I just want you to make sure if someone has posterior knee pain, that it is not an anterior knee problem, and all the swelling has dropped posteriorly, that is why they are feeling the pain there, and teasing out whether they truly have a posterior knee problem. You are going to have to make sure you evaluate both and know when to recognize the difference between edema pain from another injury or true localized pain from a localized injury.

Again, we are looking at the history of an ACL case. What is your different diagnosis? From that ortho evaluation, we should have come up with the unhappy triad. The unhappy triad is a term we call when we have injury of three structures in the knee. They happen all together because they are all interconnected, where we have an anterior cruciate tear, a medial meniscus tear, and a medial collateral ligament. Remember, there is a portion of that medial collateral ligament that divests into the medial meniscus. We do see those two happen simultaneously, very frequently. Because she was planted and flexed and pivoted off that leg, she tore her anterior cruciate.

Whenever you hear an athlete or a person tell you they heard a pop, particularly the word pop with a knee injury, think of anterior cruciate. Okay? Because it has a very classic sound, a very classic pop, when it gives way, and then again, not able to finish the game, too much swelling, too much pain, couldn't bear weight. Those are all the things you are looking for.

If we think about this ACL reconstruction, there is a lot of research online about ACLs, and it is kind of one of the things that I like to read about. But we really are trying to understand why do we see more females than males? Why do we see the re-tearing of the grafts, and then also the contralateral side tearing, which was the case of this athlete? She had the ACL reconstruction last year, went back, did a whole return to sport plan, and re-tore the opposite side.

Let us talk about that. First, why females more than males for ACL? Females tend to jump and land more with their quadriceps. Males tend to jump and land more with glutes and hamstrings. If we think about the origin, insertion, particularly insertion of quadriceps, and how that might contribute to ACL injury, we can think about the quadricep attachment down onto the tibia, and if we really have eccentric loading on that attachment of the tibia, we are going to facilitate anterior translation or put that under tension. We are already putting under tension the ACL. Whereas a male has attention on the posterior elements, which is his hamstrings, which is pulling that tibia back into alignment. So basically, the male is protecting themselves from ACL injury, and the female is predisposing themselves to ACL injury just based on this mechanism of action of how we jump and land. The biggest service you can do to your athletes is train your females postseason, how to jump and land, and then also do jumping landing drills. What we do is we video and analyse our athletes' preseason jumping and landing and making sure that they are trained properly in the preseason to avoid the ACL injuries during the season. However, we do see graft re-tearing, sometimes if the graft is not too tight. But then again, for everybody, you can do everything correctly and they still re-tear, we think about why does that happen?

You have this athlete on your table who came to you the day after her game, who walked in with crutches, and you saw the edema, swelling and the pain. What is your plan? You are going to treat them that day. You are certainly not going to adjust with that type of positive anterior drawer and McMurray's test is positive, valgus stress is positive. So basically, we are going to send out for an MRI, and send to an ortho for more than likely reconstruction surgery.

This is her post reconstruction. These are newer pictures. She is just come back to rehab. We can see the surgeon signature so nice here. This is the day after surgery here. This is a couple of days after surgery. I always like to look at the patterns of edema, and take note of the patterns of edema because it tells you where most of our injuries happen, you know? We think about where that healing is really taking place. When we reconstruct an ACL, they drill into the femoral condyle and they lace the ACL through to the medial tibial. So, they form a new ACL here. Therefore, we see the bruising here, and of course, here is the scope bandages. Always notice those patterns of edema and try to keep an eye on you know where we are at for healing.

Let us jump into our next case and clear our brains from that old one and start forward again. A little something different. I want you to take a moment to read it. This is a patient currently in our office as well, who's a 35-year-old male with a history of cerebral palsy. He did have his meniscus repaired in this knee on his left knee one year ago. So, same knee injury. He tripped and fell on the carpet. He has high tone from cerebral palsy. He tends to fall quite frequently, which we are nervous about repairing his meniscus because we wonder how that is going to hold up with that type of gait.

Let us go through this case. What is your Evaluation Plan? Are you going to do something different? What would you do differently when evaluating a cerebral palsy athlete? We have a lot of para-athletes that we work with. What would you do differently? Are you going to look at the same structure? You are going to evaluate him differently? Will you alter your exam? We want to think about these things as we evaluate. No, we are going to look at the same things. But understand in this cerebral palsy patient, we are going to maybe see a higher tone, we might not get as much joint gapping or as much motion unless we can really get that joint to relax. If you have high tone, and the same thing when you are evaluating your patients that are non-cerebral palsy, you need to get them to relax to get a good idea of what's happening with the joint.

I put a knee evaluation together for you; how I do it. Here is kind of my ticking points, what I like to look at when I am jumping in. And then I videotaped it for you so you can get an idea and maybe go over and over in your brain

and practice running through a smooth evaluation. That way you get all the tip ticking points done and do not forget any structure.

Let us look at this knee evaluation. We are looking at quadricep contraction, and I am looking at the symmetry of the quadriceps. Does the patella track superiorly and inferiorly? Do we get good VMO contraction? Range of motion is next. I am checking to see. This is a meniscus test too. If they cannot flex the same amount on each side, it speaks to swelling and maybe posterior horn tear. I always kind of just do a Lachman's. Here is my Lachman's here. I do a very mild valgus, and then I will take a 30-degree valgus looking for more discreet, and then I will do a varus at 0 degrees looking at lateral collateral, and then a varus at 30 degrees looking at lateral collateral. Then I flex the knee up here, and I am checking the ACL with your anterior drawer. Then I bring it right into my McMurray's for meniscus.

That is that circumduction I was telling you about. They are not going to let you bring that into flexion there. And then you check the medial and you check the lateral by rotating the foot in the opposite direction. Then I am checking quad and hamstring contraction here. Then I am checking the passive range of motion, trying to see how much flexion I can get them into. Remember when you are doing this, you are going to do it on the good side first and the worst side second.

Then I move into my palpation of structures: medial structures, lateral structures. Bend the knee and I palpate again the medial joint line, the lateral joint line, the patellar tendon, quadricep tendon, making sure I palpate the lateral collateral ligament, medial collateral ligament. Check for the popliteus here. I do both foot eversion and inversion even though the popliteus is just the one. I am finding a better result there. I palpate the pop fossa, the hamstring insertions, and the gastroc insertions. I have them check the hamstrings for strength, rec fem. There is your knee evaluation. It does not take that long to do a nice thorough knee evaluation. You can run through that quite nicely with ticking all the structures off.

There is another portion of the exam that is here. This is called your Pivot Shift Test here. I bring the knee here making sure they are passive. This is another ACL test. A lot of people do not like to talk about this test. This is an older school test, but I like to do it. That pivot shifted right there, the tibia will derotate when you get them into extension. Redoing a McMurray's test just to get a better idea of it. We are going to watch it again. The first portion of that test is the bounce home. Bounce home is when you let go of the pop fossa and let the leg drop into extension. That bounce home test kind of tells me... If you are not really finding a whole lot on somebody, let us show you the bounce home. Really making sure they are nice and relaxed here. There. That is a bounce home test right there. What I am looking for is do they have any pain? Are they sensitive? Because even in the most discreet knee injuries, that is going to be painful. If that is not even a little painful, then I am really going to start my hunt to see what's going on and why they have pain.

This test here is Thessaly's test. This is the one that I said was the most sensitive for meniscal injury. Basically, they are going to stand. Holding onto your hands, they are going to flex about 20 to 30 degrees, and they are going to rotate on that foot. You are just kind of loading and grinding the meniscus, you can see why it is such a sensitive meniscus test. If I cannot find a positive meniscus with McMurray's or palpating the joint line, I always stand them up and do Thessaly's test. It is a nice exam so that you really can pick up most meniscal injuries. Let us watch that one more time. This one is really important.

Now you are building your knee exam. Let us go back to our case study. Here are your findings. I want you to read them and just think for a minute to see what you think is going on. He is ambulating with the straight leg. Is that CP related or is that pain related? He has edema. His pain is over the medial patellar border. This area here is where all his pain is. He does not want to flex his knee because it makes him nervous to flex it, which is a big red flag. His medial collateral is negative, lateral collateral is negative, anterior drawer is negative, negative posterior sac. Okay, so what are you thinking? What structures are you thinking about? I worry about this medial patellar border here. When someone has pain here, and they do not want to bend their knee, I think of patellar dislocation. They are going to tell you it felt like it popped out, and when they straighten their leg, it pops right back in. It is like a subluxation. That was my suspicion with him. He did tear his MPFL, medial patellofemoral ligament.

What is your treatment plan for today? He is sitting in your office on the table. What is your plan? He's a bit of a crossfitter, and he is like, "Can I work out?" What's your plan? I love when people say that when they are laying on a table looking like that. What's your plan? What are we doing? I want you to think about how you are going to guide patients with injury and how you are going to direct them about training and not training. Remember, when we are talking about athletes, sometimes you need to think about goal setting, and we need to think about communication, which is very important. But for that day, it is palliative care. For that day, it is ice, low level, maybe interferential current type stims, elevation, and then wrapping and bracing in full extension until we can get him to get to a referral.

When thinking about this case, does your evaluation add up to the pain? That is for all the cases that you are going to see. I want you to think about your diagnosis. Does it match the mechanism of injury? Does it match the patient's complaint? Do all the answers get satisfied? Do all the questions get answered? I should say does it answer the why? Why did it happen? That is your functional evaluation question. Not only do I have a medial collateral ligament injury or a patellar dislocation, why did it happen? If we think about a CP patient, they have very high tone, and with very high tone, that is very strong quad contraction. The three muscle, lateral quadriceps muscles versus the very weak vastus medialis is not much of a competition. You throw into it a force of tripping, and there goes the MPFL. The medial patellofemoral ligament tears easily.

This is him post-surgically here. And then this is the first day off with the wraps post-surgically, just checking the wound. Sometimes what surgeons will do if the surgeons are at a distance from me, and I refer to them, they will send the patient back for me to keep an eye on them post-surgically, just making sure the wound is healing without signs of infection and getting the adequate passive care at home and rest that the patient should be doing, so that way, it avoids the patient doing a several hour commute in a car just to look at the surgical site.

It is very important that you understand the protocols of the surgeon if you are going to do this follow up type of work. Knowing if the surgeon wants this patient to bend his knee or keep it extended, and the whys. What is his plan? I will make sure I get a copy. Every surgeon usually has a copy of their post-surgical protocol for every injury. I get a copy of that and keep that on file so that I know he wants them in full extension for 6 weeks, or he wants them to get to 20 degrees by week 4, or what he's thinking. That way when the athlete goes back, he's satisfying his goals for each week interval. I am protecting that athlete, making sure that they are not undermining their surgery.

His surgical repair, because he was CP, they did a translation of the tibial tubercle. Instead of reconstructing that medial patellofemoral ligament completely, they know that is going to scar down, they took the tibial tubercle and detached it, and moved the tibial tubercle medially, and then reattached it back in. This pulls that whole patellar tendon and the patella with it, and translates it more immediately, and that way, it cannot dislocate. This is a firmer fix for someone like a CP patient, and that would be different for that MPFL reconstruction. Thinking too about if you are keeping an eye post-surgically, not forcing too much flexion particularly in this CP case, because it is going to pull apart this bone. Here is the bone piece right here that is screwed, and it is going to pull that right off and undermine his surgery.

This is him a couple of weeks later. I think he is at week 4 now. Surgical site is healing quite nicely. He has the ports here. You can see for him, they just moved that tibial tubercle over, more medial, so that that patella can track more in the trochlear groove as opposed to pulling it this way, because they know in a CP patient that that is going to pull too laterally. Again, we talked about the doctor's protocols, range of motion, restrictions, and surgical healing.

We are going to get into another case study. Take a moment to read. We have a 35-year-old female runner with one history of right knee pain. She admits that the knee was drained about 9 months ago, and she got a cortisone shot to it. It is increasing, it is getting worse, not better. What do you evaluation? She is obviously still running, having more pain and finding that she is getting a little bit of edema post-exercise, but it is not really limiting her range of motion, except she does have pain. She is feeling like maybe she should not be running as much. Again, we go back to our knee evaluation. Remember, do the same evaluation on everybody for the most part, unless the injury does not allow you to do it, unless it does not make sense to do it. I want to make sure we hit that. If

somebody is acute, and they have a fracture, we are not going to run them through McMurray's and do festivities and all kinds of crazy stuff. We need to tailor it sometimes, but I just want you to get in the habit of running through your whole knee evaluation, and as you get better, you will be able to omit in certain cases. But again, even me still, for someone like this, I am still going to run through the whole evaluation because there is a WHY to it. You know, there is something else that we might be missing. Maybe we are missing a mechanical fault, maybe the hip has a poor range of motion, that is why her knee is bothering her, maybe she pronates too much, and therefore the medial structures are a problem.

Again, I am going to play this one more time quickly so you can get it in your brain just for the sake of memory. Quadriceps contraction. Looking at them together now. Looking at that symmetry, that patella driving up in the trochlear groove. Having them slide their heels to their butt. Looking at range of motion actively. Looking at the good sites so you can compare good to bad. Lachman's for ACL. Valgus MCL at 0, valgus MCL at 30 degrees, lateral collateral ligament, 0 degrees; varus stress, 30 degrees. ACL again. Anterior drawer. Looking for anterior tibial translation. McMurray's test here. Circumduct. Looking for pain in that flexion. Rotating the foot in and out, doing both ways. Extension for quad, flexion for hamstring. Passive range of motion of the knee. Again, we are going to do it on the good side before the bad side. Then palpate all the structures, looking at your medial structures, looking at your lateral structures, looking at your infrapatellar structures, looking at your suprapatellar structures, looking at the joint line medially and laterally for point tenderness. Kind of think of everything in compartments. It is the easier way to think of it, making sure that you are getting all the ticking points. Checking popliteus, the most misdiagnosis of the knee, big structure. It unlocks the knee, gets that first mechanism of bending your knee going, helps to pronate, so internally rotates the tibia. Checking the pop fossa, and then a little more hamstring and glute activation.

I wanted to do those two times just to make sure that you had an extra view of that, and you can start kind of formulating your evaluation in your brain. I want you to go and practice these. Here is our evaluation on our patient, our runner: negative valgus, varus, negative drawer, negative Lachman. So, no medial collateral, no lateral collateral, no anterior cruciate, some mild pain with McMurray's test. But I will tell you, sometimes you will get a little bit of pain if they have swelling with McMurray's test. So just kind of know when it is a cartilage versus when it is not. Negative bounce home. We showed you the bounce home test. Some pain in extreme flexion. We are concerned about cartilage. Again, that extreme flexion tells me it is posterior horn of the meniscus. And then there is some pain with McMurray's. Both of those two items are saying a little bit of meniscal injury. Positive patellar grind. That is your patellofemoral mal tracking test.

I want to just step backwards one moment and look at your list. What I like to think about is doing almost two ortho tests for each structure. We have Lachman's and we have anterior drawer. Those are two tests for ACL. You are doing it and then rechecking yourself. We must test for valgus, varus, both at 30 and 0. That is two tests. You are doing and rechecking yourself. Pivot shift also checks ACL, so that is a third test. Bounce home is just checking inflammation, and the little posterior cruciate too at the same time. We also could get so many structures with the bounce home test.

Now we are doing Thessaly's on top of McMurray's for a meniscal injury understand we are almost doing two things for each knee just to keep reverifying. That is why when you make a diagnosis, you are really making an accurate diagnosis. We have got patellar grind; I see two things that are telling me I have extreme flexion. I have McMurray's, telling me to look at the meniscus and look at the patellofemoral tracking.

We sent for an MRI. Here is the MRI. Lots of edemas is a T2 weighted image. I like the T2 weighted image because it tells us where our edema is. Edema is the bright white, so lots of swelling in this knee. Here is your A to P here. Here is our medial joint. Here is our lateral. Here is your meniscus. Can you see how I am missing a portion of the meniscus here. It is just not as great. I have edema here along my distal IT band. I better make sure I evaluate for friction or tightness of my iliotibial band and tract. Lateral patellofemoral loading, we call it.

Let us jump over here to our sagittal view. We can see all the edema around the patella. We can see this edema in the distal femur. That is like what I call a kissing injury. This is trauma to this femur from this patella hitting it. Look at this traction spur superior pull of the patella here. Now if we move to this sunrise view here, whoa. Is my

patella sitting nice in a trochlear groove like that sunrise view we saw earlier? Not really. This thing is just all lateral loading of the patella. It is all deformed. We have got several traction spurs. We have something happening here with the synovium, injury here, all fluid here. Then look at the bone marrow edema in here from this guy hitting. Look at the bone marrow edema in the patella from these two hitting up against each other.

Appreciating too in this view, the difference in conformity between the medial femoral condyle and the lateral femoral condyle, really seeing that there is a difference in conformation between the two. What to do with this patient. This is a runner who's running, but pain is getting worse. I need to think about this patella tracking, if that is something that I can fix or not. Because I have so much edema here, I need to go back and look at that IT band, because clearly all the lateral structures are pulling so tight. Can I fix this problem? I cannot. I cannot change the shape. This is years in the making. I cannot get rid of this spur. But maybe I can improve the mechanics just a little bit. Maybe.

What we did for her was some McConnell taping, patellar taping. FICS has a Masterclass on just that topic. There is a whole long protocol for just the patellar taping, but as we use the McConnell tape or the rock tape or the dynamic tape also has an excellent protocol, we can realign this a little bit, the trochlear groove, and help with the pain quite significantly. We can help with the pain, we can reduce the swelling, we can release the IT band, maybe we can buy some time before this patient needs any type of surgical intervention.

Here on this sagittal view too, let us look at the fragmented piece of menisci here versus the more triangular shape here. We have got a little meniscus injury here too. Confirming that we found a diagnosis. I found this very interesting article, looking at retraining for patellofemoral mal tracking, retraining the vastus, the VMO. As I was doing some research, it is quite interesting. As your knee drops into the trochlear groove... I am going to go back one slide for a moment. What we find in this research is as this patella does not seat further into the trochlear groove. With degeneration, we lose this nice space, and it starts hitting up against this lateral femoral condyle, just like this one. As we start to see this occurring, what happens is we lose not only the VMO from pulling it immediately, but we find that the lateral structures and medial structures are simultaneously pulling it deeper into the trochlear group. If we go to train the vastus medialis only and do VMO contractions, which is important, we must understand that we are wasting our time on someone that has a patella that is sunk into the trochlear groove all the way. We need to first mobilize that patella and get it to disassociate from the femoral condyle a little bit so that it can track in any direction. Once we get that patella moving, then we go back to retraining the VMO. So always begin by assessing patellar mobility and making sure we have patella mobility before we are training that VMO. Otherwise, we are going to get vastus medialis and lateralis simultaneous contraction, and you are driving it deeper into the groove. We do not want to cement a problem in. That is really what this article talks about. It talks about that timing of muscle re-education. We want to make sure we have a free moving patella prior to getting that VMO activated.

Here is our torn medial patellofemoral ligament here. See how this guy is stretched out here. Just wanted to show a picture and idea. It is supposed to be attached right here onto the medial border of the patella. See how this lateral patellofemoral ligament attaches and divests right into the patella. Can you see how this one does not any longer attach to the patella and it is kind of retracted a bit? That is a torn MPFL.

If we look again into the research of how we manage patellofemoral pain, we really talk about unloading the knee. We want to think about our treatment strategy should not be painful action, should not be things that cause pain in the knee while they are doing it. We need to think about doing activities that retrain the quadriceps, the vastus medialis, adductor group focused without causing pain, and then reintegrating more functional movements. Offloading the knee is really the key there.

How do we begin in this runner? And how do we get them retraining so that we can still get some type of activity? I want to think about athletes, they need to be active. They want to be active, and if you tell them, they are not going to be active, they will be active anyway. You might as well form a strategy with them. We want to think about what's your plan. Do we have full range of motion? Do we have strength? Do we have stability? Do we have proprioception? Assessing these things in your evaluation and deciding what can and cannot we do with rehabilitation. What's our overall plan? To get this, we need to understand our goals, and not only your goal, but

you also need to understand the goal of the athlete or the patient. And then you need to align your goals together.

So having a conversation, typically on my first day of visit, I will be evaluating an injury, and then as I take my history, I will ask about their goals, because I want to hear where their brain is. If it is just able to walk a mile a day, great, then my brain is set in one direction, or if it is to run an ultra-marathon, my brain is set in a different direction. I think you need to understand the patient's goals, and then you need to align their goals with your goals, so that you all are on the same page.

What are your timelines for this athlete? Do we have a big competition coming up? Is this athlete training for a marathon? What is my timeline? Do I have 6 weeks, 8 weeks? Or do I not have a timeline? That also is going to significantly change your rehabilitation protocol. Not only what's required of that body part, but I want you to think about what's required of the whole system, fatigue-wise, endurance-wise. How many muscle groups are involved? What type of activities as a gymnast, a runner, lacrosse player, a football player? We need to think about a rugby player. What do they need to do? What do I need to do to get their physical body ready? Because we must understand if they are out rehabbing their knee, what are they doing with the rest of their body? And how are they circumventing a problem in an injury in another area of the body from disuse? So how am I going to cross train them, in other words, in a safe way? Keep that in your mind as you are working with athletes that need to be doing. Can I have them lifting or doing upper body stuff while I am rehabbing their knee? Yeah, most times you can in a safe way. I just want to make sure that we really talk about what is the safe plan?

Our onset of rehabilitation. What are we going to do first, second, and third for a knee? This is our post-surgical ACL we saw earlier. This was her just a week or so ago in the office. Our first step is always with the knee, is to get that quadricep contraction. Some of the newer research tells us that when we have inflammation in any area, the muscles surrounding that area tend to shut off. They just completely shut off when there is inflammation in that perfusion. Then we have got to think about a post-surgical knee. They fill that joint with fluid, and there is edema and swelling post-surgically. How do I get that quad to remember how to contract? That is your first action with any rehab. It is your first step. Basically, getting that quad to remember how to contract efficiently, and then we are doing it. It is a great learning point for the quad to contract the VMO first. This is a very, very passive light, contraction day for her. We are just going to have a little bit of very, very light Russian stimulation, not contracting too hard, just contracting VMO, and then the rest of the quad. As we progress on, I am going to move my electrode here down closer to the VMO. Move this a little over. That way when the Russian stimulation comes on, it contracts that VMO first, and then I will have the patient doing a quadricep set with them. Quad set would be as the stim turns on. I want you to push the back of the knee into the towel and I want you to squeeze your quad.

Day 1 for her was just having the stim on. We are doing some swelling reduction with some elevation and what not. But just having the stim on to pump the quad, lightly, will be day 1 for her. Her home instruction will be, "I want you to squeeze the quad 5 times every hour." When you squeeze that quad or try to contract it, it acts as a pump mechanism to flush the swelling out of the knee. You have them do that every hour just about five times. You do not want to overdo it because you do not want to cause patellar tendinopathy by them squeezing.

Then we will be moving on to quad sets, where they are pushing the back of the knee into the bolster or towel, squeezing that quad. We use it with Russian stim. The stim turns on, activates the VMO first, then they activate the rest of their quad by pushing that knee and tightening the quad at stage one, and that'll look like this. Here. As she progresses, she's going to push that knee into the bolster, and then straighten it here. We will do that with the stim just as I showed you earlier. But this will also be her home exercises to do. My direction is pushing the back of your knee into the bolster, bring your toes to your nose, and squeeze your quad tight. Remember you are reteaching that quad to contracts. You want to take full advantage and teach it to contract appropriately.

Let us look at the second progression then. It would be a straight leg raise when you do your set. Here, you turn out and lower. Quad set first. Raise to the height of the opposite leg, turn your foot out and lower. Raise, set, turn out slightly, and lower. We are turning out slightly so that we can really focus on that vastus medialis eccentrically on the way down, because we really want to take advantage to get that... We need a little extra to get that vastus

medialis working versus all the other strong ones. I have them bend this other leg up just so that they know the height to raise that leg. They are going to be raising this leg to match the height of the other leg. Let us look at one more clip. That turning out is very important, really feeling that muscle contract. That is your progression.

Then heel slides. That is something they are going to be doing at home. They are going to be doing it in the office at first to make sure they know how to do it appropriately. Basically, what they are doing is their heel is on a towel, and they are sliding their heel to the butt. That is the direction. Sliding your heel to your butt and extending. Their goal is to slide it gradually more and more each time. Each time they are bending their knee, it is getting a little more flexion, a little more flexion. In the beginning, they are not going to get full 90 degrees or full flexion. But that active range of motion will pump the swelling out of the knee. You want them getting used to actively doing and partaking in the activities post-surgically and during rehab too, and without non-surgical cases as well, and making sure that they are trying to kind of slowly get it a little further each time. You want them to match the amount of flexion they can get in the good slide over time. Okay, so that is your goal.

Now we are beginning our posterior chain activation as we progress on. Very important to not neglect the glutes and the hamstring complexes when you are rehabbing a knee, particularly glute medius and good glute control. Very important for the knee. We talked about that jump landing drill, how we want their glutes and hamstrings to contract. Particularly, we want hamstring activated so it can act as that check strap for ACL injuries and preventing knee injuries. They are going to be doing a glute bridge which looks like this. Pretty simple. Really feeling they are pushing through their heels and squeezing their glutes at the top of that motion.

This is an example of using dynamic tape to do McConnell taping. This is great for pain relief, again, I am going to point you towards looking at the patellofemoral masterclass that FICS has on the website for more training and how to kind of do this type of procedure, but it is also something else for patellofemoral pain.

Moving on for the patellofemoral patient, these are good for all knee rehab, these exercises. As you progress, pretty much almost every knee injury is going to be going through these. Then we are going to move on to our standing activities here, which I like to do banding. I like to do it with a weighted ball to contract the upper core, get the core stabilized. This is double bands. This is a gymnast, and you are instructed to lift and hold each step. And then we do the same thing backwards. Here. This is a weighted ball again. You are really holding your core and you are really tightening at the top of that action, really squeezing your glutes, really squeezing your glute there. And then we will do three sets of 15 in each direction.

One of my very, very favourites, this is more of your commando walk or your monster walk, forming that C shape. We got to get the glute medius activated for all our knee injuries. Very important for good knee control. We will be doing this forward and backward. Very good glute med. If we really want to get those glute med functioning at high force as we progress, we are going to get them on a treadmill and we are going to have them walking on a treadmill here with a wide gait. Her instruction is to pretend that the balance beam is between your legs, and you cannot touch it. There is a line on the treadmill that you are on either side with your feet, and you are walking. We will start with just 30 seconds of wide walks on the treadmill and a 15 second break, working up to a one-minute walk with a 15 second break doing those four times. That is great for glute med activation.

When the glute med activates, it de-loads the medial knee, it takes the stress off the medial knee. It helps prevent pronation. If we help prevent pronation, we prevent tibial internal rotation, we prevent a valgus stress on the knee. Getting that glute med activated is super important, super important. I cannot stress that enough. Again, activating that posterior chain, making sure that we do the Swiss ball actions which are so great for posterior chain. This is a little bit of progression, so this would be more for glute, high hamstring. They will be doing sets of 15.

This bent leg is a little more difficult. Here, this is the hardest progression of all the exercises. They will do this activity last in our Swiss ball progression. This is the step before that where they are doing a double extension here. Really, hard stuff. That is great. You have got to get the posterior chain working very important. Our first stage of those Swiss ball exercises would be a double leg on the Swiss ball, and then you can move on to a single leg. This is a single leg. So, you just do the first thing with double leg, and then as they get a little bit better. You

can see that she is super coordinated and very fit. I want that good hamstring, good control of the knee. We cannot forget about any structures.

As we get them back into activity, we are going to have her running on a mini tramp at first just to practice loading. When we are doing that, we are looking for pain. We are talking her through different actions: ins and outs, forward and back, two feet forward, back with one leg. But we are looking at how she lands and takes off and looking as she bows in if she valguses. For her, her knees drop together there. See that? For this athlete on the left, I am going to make sure that I am doing more glute med work with her.

I wanted to show this one as a comparison with different levels. You see how she struggles a little more with this one than the previous athlete. I know that she's got a poor posterior chain activation, and I really need to focus on that. She's struggling with that activity. Understanding who you are working with and where you need to start, and also noticing when they are struggling what you need to focus on, or maybe you need to back it down to a more novice version of that exercise so that we are not causing injury. I always move into, particularly for knee injuries and ankle injuries, a hopping progression. Hopping is very important if we are going to have any athlete that does any activity like running at all or jumping. They need to be able to hop on one foot for an extended period. Understand that a run is really a sustained hop. If we think about getting them started on our hopping progression, first, we like to start with simple two legs, forward and back, and side to side. I formed this X on the floor here, and you will see it. First, I will have her go forward, back, forward, back. I feel she is good with that, and then we will go lateral motions, then she will progress here to an X pattern. She is a status post MPFL reconstruction. She had a dislocated patella there.

Making sure as I am returning to sport, I am returning better than before. That is my goal, and that should be your goal. When you are returning an athlete to sport, return them better than they came to you, because they came to you sometimes from traumatic injury, but sometimes from a mechanical fault. I want to fix that before I send them back.

This is our ACL. We had her activating posterior chain and we put the bands around her knees, then we load her glutes up. We have her do hip thrusts on a bench, really making sure that we are just loading her up.

We want to know what is very interesting when we look at squat patterns of athletes, and we talked about that jumping, retraining, and really looking at females versus males, if you are using your quadriceps or your hamstrings to jump, and I want to make sure I make that correction. I thought I would show you a video of some jumping here. This is a good jump with good use of hamstrings and glutes. But what I want to do is I want to just kind of stop there, and I want you to look at this line of the tibia. If I drop a plumb line down from his knee, it drops right over his second metatarsal or so, metatarsal phalangeal joint perfectly. The more that that knee drops in front of your toe, the more knee loading we have. That is too much knee loading. We want to think about instructing. Therefore, girls are different from guys. Guys tend to keep their hips back when they squat, which is proper mechanics. Girls do not. Girls lean forward on their toes, overloading their knees which predisposes them to ACL injuries. As we do this jump retraining, making sure that we have good mechanics of the jump. We are trying to keep that tibia behind the toes and making sure that we are really using glutes and hamstrings in our jumps.

Our progression with return to sport. They must pass all types of jump progression. We are going to start as they start really going on, just getting them down on the turf. We have a turf in our office for return to sport stuff and making sure that they can jump side to side now. As I am noting, I always will do a bilateral comparison and make sure what she can do on her injured side is what she can do on our uninjured side. Well, there is an ankle injury waiting to happen. I need to make sure that I haven't overtrained the good side, and now her bad side is a deficit too. Because that can happen. So do not forget about, as you are bringing them back to sport, training the other side and checking them bilaterally, making sure that we are running through all the protocols.

Our next progression from just those lateral hops then on the turf will be straightforward with a little bit of a figure eight. I am going to do a straight and then a turn, making sure that she can hop for a sustained period on each foot. Then I am going to change the cones, and she's going to have to do a hop diagonal to each cone on that foot, and then she will have to come back.

Think about as we are getting somebody back to sport, not only stopping at their pain being gone or their inflammation being gone, but you have also got to take them all the way. You really need to take them through the whole return to sport plan and thinking about what are those sports specific drills they need to be able to do? Even if they finish the hopping progression and they finish the cone progression on the turf with hopping, now what do we need to do? Is it a marathon runner? Is it a sprinter? Is it a hurdler? Is it a gymnast? Is it a soccer player, a rugby player? Now what do we need to train specific to that sport? That is very important and incorporate that in your rehabilitation protocol. Let us not forget about gait analysis. Very important that you are looking at their gait, you are getting them on a treadmill, you are video analysing their movement patterns, answering why the injury happened. Injury did not just happen, it happened for a reason. Making sure that it is not a mechanical fault that you can correct before returning them back.

Here is our return to sport kind of tick off list here. Can they walk without a limp? That means they can progress to the walking therapy. Can they run without a limp? Then they can begin short distance running type of activities, therapeutic exercise. You begin your sports specific exercise as you increase function, keeping in mind what sport you are returning them to. Begin always with straight movements, and make sure you are always working proprioception from an early point in rehab, strengthen the region, and then strengthen them globally. Do not send them out with other decreased atrophies that have occurred from reconnaissance of the injury. Add in time and intensity to each exercise. Maybe do 5 repetitions in the beginning, and then you are doing three sets of 15 in the end. A continued strength and plan. Make sure as they return to sport, they have a plan with the strength coach on how they are going to continue that plan and keep improving. This is a very important list on how to progress and how to keep them healthy.

One of our last case studies for today is going to be a 13-year-old male lacrosse player. We are just going to go through this one quite quickly because I just want you to be able to kind of gather a different view on an athlete. This athlete got clipped at last night's game. This was a real patient in my office with his injured knee. He reported to the athletic trainer on the field, he could not walk off the field, he could not stand and bear weight. They sent him home with a brace and told him to follow up with ortho. He came to my office the next morning. What are your first questions? Again, how did it happen? What's your mechanism of injury? At this point in the lecture, you should be able to understand you need to get that down first. Mechanism of injury, history of previous injury. Could you walk off the field? Did it swell or bruise? Are you walking today? All these things should be the first questions you should be asking.

This is his knee the day after. Understanding what we are looking at here on this knee. You can see the bruising patterns. I love to look at bruising patterns. They are significant because they tell me more severe injury. If somebody walks in with this bruising pattern in the morning after I am worried about a fracture in this area here. If I am thinking of fracture there, am I going to necessarily run through a whole knee evaluation? Heck to the no. That is something we are not going to necessarily do. If I am suspicious of a fracture in this area, then what I am going to do is I am going to just try to palpate structures I think is a problem. I am going to just probably do a little bit of a Lachman's, a 0-degree valgus, 0-degree varus, see what I get, see if there is stability. That is all you do. I am not going to overly force this knee. There is a lot of swelling. Notice a lot of swelling distally, even up proximally. This is a severe injury. This athlete has a medial collateral ligament injury rupture. This athlete has a medial meniscus tear, has a fracture of the tibial plateau. ACL and PCL both torn, lateral collateral ligament torn, meniscus torn. You will not see any like this in your practice, hopefully for many years, or if ever. There is nothing left in the knee holding it together. So why do I need to go through the whole evaluation? This is a brace and refer. He needs a whole knee reconstruction and that is exactly what he had.

Understanding that my job that day is to brace it and get him to an ortho ASAP so that he can get an MRI on him and get him into surgery as soon as possible. Maybe we will teach him some what we call prehab or quad contraction exercises, teaching him some transition skills, how to get up and down without injuring, how to walk on crutches, make sure the crutches are fit appropriately for him, making sure he is elevating throughout the day and icing. Those are just kind of like your checklist.

With an athlete like that we need to understand that sometimes we have got to educate the parents or the Guardian on what to expect and how to care for this person, what they should and should not be doing at home.

Be honest with your athlete's best interest above everything else. Making sure that you are informing them appropriately and not being an alarmist and saying, "Oh my, there is nothing attached." Making sure we are just getting them braced, getting them safe, and truly getting them somewhere where they can get the best care. Be honest with them. That is what it comes down to. We want them to get better, be safe, be able to stand and walk, and be active as they get older.

Speaking of this case, does the age and gender of the athlete matter? What are some considerations for pediatric athletes? You know, we have growth plates that are open when kids are younger. We need to consider the older athlete as well, how those injuries come into play, and what's different in the female athlete? You are going to be seeing some of these lectures as you get further on if you haven't seen them already in the ICSC. We will have lectures on each of these aspects.

Understand there are patterns of biomechanical faults and injury. We need to look at these patterns of use. This is a meniscal injury patient. Well, I can see she has a meniscus torn on the left side that was undiagnosed for about a year. Look at this callus here. She's clearly using this foot differently than this foot. She's using this differently than this, even though she has a greater Hallux valgus on this side and she's towing off on this side. I want to look at the gait. Get the shoes and socks off your athletes, making sure you are looking at the muscular contour, look at the quadriceps look at the gastrocs, look at the hips, look at the glutes, the hamstrings, making sure that we are looking for symmetry differences that answers the why we have a mechanical fault. Why does this patient have this injury? Do not just stop at the diagnosis. We need to be able to get the diagnosis right, laser-focused diagnosis, then open up. After we get that diagnosis accurate, making sure we are doing the right treatment, open up for the whys. Why did the fault happen?

Understand there is a cascade of injury. When we have injuries, sometimes it is not just one injury. We have an athlete here who had medial tibial stress syndrome, bilaterally, pretty severe for a period of time and trained through it, and that is a coaching problem, which is a whole other conversation. We must think about what happens in the long term with somebody like this that has a medial tibial stress syndrome, untreated? What are our long-term ramifications for untreated injuries, and how can we help the athlete at that stage of the game? We clearly can see that these long-term injuries affect these athletes quite profoundly more so than just physically.

If we look at the anatomy, we see scar tissue forming. This is an anterior compartment of a lower extremity gross dissection that I was doing in the anatomy lab for a lecture. We can see the scar tissue that forms in these compartments, and we think about untreated medial tibial stress syndrome. Really what they are coming to now is that it forms a lot of scar tissue not only from the periosteum to the anterior tibialis, posterior tibialis structures, but also just right in the lower extremity. Could this be contributing to this chronic long-term pain that is being diagnosed as compartment syndrome for some of these athletes? We think about this diagnosis. See her posture. I love to look at static posture sometimes and see if that is contributing to injury. She kind of has this forward posture, so she is loading her anterior tibialis all day. Can I change her posture to bring her backwards and take that pressure off of her legs?

We also can see how these treatments affect the psychological component of these athletes. The effect of the athlete. Do not forget about that when you are treating athletes too. I make mention of that in some of the other lectures. Let us not forget, with every physical injury, there is a psychological injury, and let us make sure that we are not negating that, and we are addressing that as well, appropriately, or referring them to somebody that they can talk to if there is a problem, because there is a big problem with an athlete like this that has now lost their identity. If they cannot do their sport, the thing that they are good at and the things that they are getting their dopamine addiction from all these years, from doing such a great job, they need to recreate themselves. So please make sure you are keeping an eye on that because that is a thing.

We like to do gait analysis in the office. I put them on treadmills. We look at them from the side, from the back. I analyse where their pressure is, if they are pronating, what type of footwear they are wearing. This is something to consider. We won't go over the details of it. There are several lectures that we offer on gait analysis, too. But making sure that we are looking at them functionally is the point.

Here is an athlete that came in with knee pain with running. I just wanted to show this little bit of a running gait. Can you see how she is standing, is there any way possible she would not have knee pain? I do not think so. We need to make sure with athletes like this, that we are looking at. I am going to play both at the same time and look at their footwear, because the footwear is critical with any type of gait, any type of running athlete. It is critical. It is their tool. It is their instrument. This athlete was running on a size and a half too small for her, and that was the problem. It is just painful to run. Once we got her in a good running shoe, with some good stability checks, she ran just fine. So sometimes it is something simple. We can do all these fancy evaluations, and it is something that is not so hard.

Want to throw a consideration out. This is me working at World Games for FICS, which is super fun. I hope to see some of you out working some of the games with us in the future. You might only see an athlete one time if you are working events. Make that one-time count and also guide them correctly, making sure that we are just doing the appropriate thing at the appropriate time. Effectively, communicate. When you do some sporting events with FICS, you might be working with people that speak a different language than you. We have got to figure out how to communicate effectively with them, and make sure that they understand their injury.

Do not forget to check to make sure that our athletes are lacing their shoes and also non-athletes are lacing their shoes appropriately, and that they have them tied all the way up, and they are not that fancy non-tied way that they have their shoes. I always make sure I check how we have them laced. This is a great way to lace a shoe for someone that over pronates. It is called a runner's knot. You use that extra little loop on the top that people forget about all the time. You lace on the same side through that, and then you cross-pattern the tie, and this will lock up and make a little more stability with the heel counter. Because if your heel is moving, your foot is moving. If your foot is moving, you are pronating a little bit more. You are pronating a little bit more, stress on the knee. I will walk them through and tie their shoes for them. Then put them back on the treadmill and evaluate them to see if that made a change.

Remember our return to sport plan. What is your measure of ready readiness? We slowly have them do. When we feel they are ready, they are going to have the instruction to go to practice and just do some drills at 25% for half an hour, and then 50% for half an hour, and 75% for half an hour. Then we are going to increase their time and intensity. We are going to gradually increase their time and intensity till we get them back to contact or full return to play. Understand there is a progression involved when we are returning somebody to sport. This is me in Poland at the World Games for FICS.

Look beyond the obvious. Explore all aspects of injury. Understand that the injury sometimes is a ramification of many faults before it, tracing that pattern back and have some fun with that.

Thank you for your time and dedication to this amazing profession. Thanks for FICS, and good luck completing your ICSC. I hope to see some of you at some future games.

[END]