

## **FICS ICSC LOWER EXTREMITY (LE) Assessment**

**Thomas:** We are going to talk about the lower extremity injuries in sport today. My name is Thomas Jeppesen, and I am a Danish Chiropractor, studied at the AECC, graduated in 1997 and been in private practice in the UK ever since. I completed my ICSSD as it was called at the time, in 2003 and I have been doing a lot of work at FICS events and the other sports events since then, it has been a very big passion. It is something that I really enjoy being part of, because it gets you meeting so many interesting people, learning so many new things, meeting lots of people both athletes, and other chiropractors that you have something in common with already, that are willing to volunteer their time, and I find that quite an amazing thing to happen in chiropractic.

**Pete:** I completed my chiropractic studies in 1996 at Macquarie University in Sydney. I went on to complete my sports masters in 2000, and FICS diploma ICSSD shortly afterwards. I had the pleasure of being able to travel around the world at sporting events, with FICS and other sporting teams as well. I hope that you all get the opportunity and joy of getting involved. Pretty exciting with the Olympics coming up in a couple of years' time, which will be amazing to work with. Recognizing that what we are doing today is going to be just a brief overview of some of the things you might come across commonly in a lower limb. So, Thomas is going to start us off, starting at the hip working our way down, and then, I will finish off the presentation a bit later. Thanks, Thomas.

**Thomas:** We are going to start off with the hip injuries. We are going to go over a femoroacetabular impingement, labral tears, slipped capital femoral epiphysis, avulsion fractures, and groin injuries. These are some of the more common ones we see in everyday sports chiropractic practice. We are starting with the femoroacetabular impingement, FAI. So for femoroacetabular impingement, you have three main types; you got the pincer type, which is a kind of impingement that occurs because of extra bone extends out from the normal rim of the acetabulum and that can crush the the labrum underneath that prominent rim of the acetabulum. Coming up as a tip here and causing pressure that can cause damage to the labrum underneath.

You got the CAM impingement, where the femoral head is not round, and cannot rotate smoothly inside the acetabulum. You get like a bump formed on the edge of the femoral head that grinds the cartilage inside the acetabulum and then it causes stress and harm to the labrum and into the joint itself.

You have a combined type, where you get both, which is actually, according to research, the most common type, that is a bit of both especially common for the chronic type of impingement.

Impingement syndromes are more likely to happen, due to repeated contact between the acetabulum and the femur. In the short term, that causes inflammation or synovitis, and associated pain with that.

In the longer term, it can also cause labral tears and progressive damage to the articular surface, and it has been thought that osteoarthritis can be a progression of that, in some cases, but the CAM lesion, the one with the little bump forming on the femur, is often actually an anatomical deformity and not necessarily caused by sport. So you may have that anatomical issue that predisposed you to getting the pain and these problems.

The history that people usually come and complain of, is an intermittent and anterior hip pain, or lateral trochanteric pain, you can have both, and it also can refer pain into the low-back, the buttock region, and into the knee. This problem tends to happen to people from the age of 20 to 50 years of age, where the average age is 33 to 35. So, again it is the main sports time for a lot of people. It does increase with activity, especially with flexion and rotation of the hip, and gives you a very 'stiff and difficult-to-stretch feeling'.

As things degenerate, the labrum and articular cartilage symptoms gradually get worse and it does tend to get worse with continued athletic activity. also prolonged sitting and walking. Sitting for any length of time makes it feel very stiff and irritated when you get back up again. It is quite a typical symptom.

Often, the athlete describes a dull ache into the anterior groin, which can be a sharp pain. It tends to be like a short sharp pain, if it is a sharp pain and they do get episodes of catching, locking or giving way, especially if you get the labral tears into that as well, as it is a typical thing to happen with labral tears. There is a feeling of discomfort and apprehension, they said if people sit for any length of time, especially with the hip flexed quite a lot.

I work a lot with basketball, one of our basketball players is 27 years old. When he was a new player to the team, he complained about his pain while playing in Spain before. He was complaining that his hip was stiff and achy, and when he was playing, doing certain moves, it was painful. He had an MRI scan and this is the result of the MRI scan. He had bilateral CAM-type femoroacetabular impingement with advanced osteoarthritis of the right hip with subarticular bone marrow oedema, cystic changes, joint effusion and synovitis, intra-articular body formation, and he had a degenerative labral tear on his right hip, which was of course his worst one. Basically, he had almost no internal rotation and pain was a lot more pronounced if you added flexion, and either internal or external rotation. He managed to play the season and he decided to retire because it was causing so much bother, instead of going to have surgery on his hip as he was not ready for that yet.

Examination for FAI, tends to show decreased internal rotation, especially in the asymptomatic athlete this can be the only thing you see. If the athlete is symptomatic, it tends to be worse with flexion and internal rotation..

The main investigations would be x-rays or CT scan but if you want to see the labrum you need to go for an MRI of the hip or/and arthrography as this a lot better way to see the labrum.

FICS ICSC LE Assessment Dr Peter Garbutt and Dr Thomas Jefferson , June 2021

The main test to do is the FADIR test. Could read all those for you but I have got a couple of videos that I have taken from a few different websites. So, I am going to show you a video of how to do this first of all.

### **WATCH VIDEO – PROBLEMS WITH THE SOUND ON VIDEO**

Basically, what they are saying is that for the FADIR test, the sensitivity is 99% but specificity is four (4%), so it is not an accurate test but it is sensitive for any problems that you are getting around the hip. Have your patient lying supine, and the examiner bends the affected leg 90 degrees and then you do adduction and do internal rotation of the thigh to see whether you get any groin pain associated which is usually indicative of an issue with the hip impingement. You should always compare both sides.

### **WATCH VIDEO – PROBLEMS WITH THE SOUND ON VIDEO**

The McCarthy test is another one, we are going to commentate that one as well. These have, let us say, questionable values because they are not very specific for these problems, but they show a general issue and when you put the different tests together, you get an idea.

The main thing you do is that, the practitioner will flex both hips to the maximum, you will then get the patient to hold on to the unaffected leg, and will do external rotation and pull the leg into extension, and move up and down. Same thing with internal rotation of hips and extending it, a positive test would be showing clicking, or pain. If there is clicking it can be an indication of a labral tear as well.

Then, Faber test is just our normal knee bent to 90 degrees, and then externally rotated and we will see how that feels.

Now you are looking at the radiographic exam taken from Brett Jarosz' article. I will give you details for them later. Brett is an Australian chiropractor who has done quite a bit of research into FAI, and written a couple of articles that are very good.

Just to show here you get both the CAM and pincer lesion here, you have a little lipping of the acetabular rim and you have, what we call, pistol grip deformity, or tilt deformity that is the lump happening on the femur here. If we do a lateral radiographic exam, again you can see the two bits here.

These are the details for Brett Jarosz, an Australian chiropractor who did a couple of articles back in 2012 in the Chiropractic journal of, Australia. Some really nice articles with some good information in there.

Treatment for FAI impingements tend to be, first of all, to decrease loading activities. Modify what they do, modify the bit that causes problems. Then hip mobility stretches, getting in do as much mobility work as you can, get them moving in all directions, slow stretches, increase hip strength and work on

proprioception, rest in the painful phases particularly. FIFA which we have taken some of this information from, we will say that nonsteroidal inflammatory is in the acute phase and can be helpful to get people going. If there is no response within 3 months, FIFA says you should consider surgery, Osteoplasty, where they go in, and they shave off the bone making it smooth and round, so it slides better within each other.

**Labral tears**, the impingement and developmental dysplasia of the hips are two of the main things that are shown to increase the likelihood of labral tears. They tend to develop gradually due to repetitive microtrauma, but around 25% will occur from a single event trauma. So hip dislocations, road traffic accidents, a hard fall onto the hip, anything like this could bring it on as well.

History is important because there are certain bits that are pathognomonic for this. So if you have got pain and mechanical symptoms tend to be a deep and localized pain in the anterior groin and inguinal region, which can refer into a medial thigh, greater trochanter, or buttock. There tends to be episodes of sharp pain on pivoting and twisting and you get catching when getting up from sitting, whereas with the FAI, tends to be more of an ache, a dull irritation, and you get more of a catching pain with this here. Just a little bit of anatomy, so you can see how you got the acetabular labrum here, and that is where it can get pinched, irritated, and damaged here.

On examination, some of it is the same as for the impingement syndrome. You tend to have pain and combined flexion, adduction, and internal rotation. It is the same tests, the Faber, the FADIR and the McCarthy tests, and you tend to get, if it is a bad tear particularly, clicking with it. But as we said before, none of the tests are very specific, but if you put it together with the history findings, then usually, we can diagnose these things.

Imaging tends to be x-rays or MRI to start off with. They say a pelvic MRI has a relatively low specificity and sensitivity for finding labral injuries. If we do a dedicated hip MRI, you see it a lot better and especially if they put in some contrast into the joint, it is quite easy to see it well. When we do imaging of these types of things, we need to remember that labral tears can be asymptomatic. So it is something to think about, that you can have a tear and some damage without it actually being the problem. So we need to put everything together.

Here, we are looking at a labral tear. You can see with the contrast media in the joint fluid, you can see the damage to the labrum here.

The treatment for labral tears, they can respond to conservative treatment if there is little or no femoroacetabular impingement involved. This is one of the main things. If you have a lot of femoroacetabular impingement involved, surgery is often one of the main things if they want to keep playing sport at quite a high level according to FIFA. They do say that it is worth trying altered loading, hip strengthening, proprioceptive exercises first, and you will find that a lot of people actually will respond well to that.

**Slipped Capital Femoral Epiphysis.** I will only talk very briefly on this because it is something we do need to consider in the younger athletes. Tends to happen more in either overweight or tall and thin athletes. It tends to be a gradual onset of hip and knee pain with it as well. In early stages, you might normally feel pain when you are walking and passive hip movements but, again if patients come in with these symptoms, with a lot of pain, and unable to weight bear, it is very important to get them x-rayed, AP and frog leg as soon as possible because they do often need a surgical fixation in order for it to get normal growth and normal function afterwards.

**Avulsion fractures of the Pelvis.** This is something that is relatively common in the adolescent athletes, because there is a relative weakness between the apophysis compared to the tendon. Especially in the growth zones of course, and they can occur when an explosive muscular contraction such as sprinting, kicking, jumping, will pull the tendon where it attaches into your apophysis and cause a separation of the apophysis from the bone. It is more common in males than females. We had one of our associate's sons. Well, he was 13, 14 at the time, and he had been playing sports in school and had groin pain ever since. She asked if I could have a look at him, and he told me that it happened when he was setting off to run when he was playing football. Then he had a lot of pain whenever he was moving. So again, we found, when we put the fingers on the area where he had pain it was very painful. So we had an x-ray done, and it was an avulsion fracture of the AIIS. It is quite common in young athletes.

If you look at this, the apophysis in most of them appears at 13 to 15. lesser trochanter is a bit earlier than that, and it closes for the AIIS (anterior inferior iliac spine) at 16 to 18. The rest 21, 25. It can happen anytime in this time zone here tends to be more towards the earlier because they do close more and more as you grow older.

Most frequent sites affected are the anterior superior iliac spine, the anterior inferior iliac spine, and the ischial tuberosities. According to the British Medical Bulletin, they actually account for up to 16% of sports injuries in children. You can see if you treat adolescent athletes, adolescent sport teams, it is not an unusual thing to be able to pick up. Just to show briefly where the different sites are, abdominal muscle attachment on to the iliac crest, greater trochanter - the abductor, lesser trochanter - the iliopsoas muscle, ASIS - the sartorius muscle, AIIS -rectus femoris, and ischial tuberosity - hamstring muscles. So these are the typical areas where you got the growth plates and where you get the avulsion fractures.

Often, the patient will present with a history of sudden pain during a forceful muscle contraction as we said from kicking, sprinting, gymnastics, anything that where you need that explosive force in. They will often associate this with a popping sound or sensation when it happens, and the acuity of the history does help with diagnosis as I explained for the young patient I saw. He explained these things and you could put your finger pretty much on it.

On examination, the patient has local tenderness and pain at the site, and often made worse by passive stretching, activity, or an active contraction of the associated muscle groups and is relieved by rest.

According to the medical bulletin from December 2016. The best thing to do is x-rays. You can very easily visualize the fractures on an x-ray. Especially when they are a couple of days old.

Treatment, most of the time we do not need surgical intervention. Rest and gradual recovery and rehabilitation programs are needed. So take it steady. Do not do the things that hurt you, but they do say that if the displacement is more than 30 millimeters, you could consider surgical fixation because it can alter the growth plate, it can alter future growth, and other problems with it as well.

Here we are having a look at the AIIIS. You can see the traction bit in here, and ischial tuberosity as well, where you can see that lifting up off the growth plate in there.

Prevention is one of the things that, according to the British Medical Bulletin, is very important to look at. It does take a lot of involvement of sports coaches and even the young people often should get involved, and the parents as well, because the important thing is to reduce the training load during the rapid growth periods. And if you do regular measurements of the height of the athlete every 3 months, you can see when they start growing fast. And then you should alter the training programs to cut it down, and one thing to do is to vary what they do, so they are not doing too much of the same thing but also to say that the quality of the workout is more important than the volume. So make sure that they do the right things and make sure that they don't do anything for too long.

**Groin injuries.** Something that is very common. If we are looking at the world conference of groin pain in athletes in 2014, they say it is extremely important to have a systematic approach to this. Location of pain is really important. If we are looking at a more anterior groin pain, mid-portion of the thigh area, it is often the iliopsoas region. medial groin, often adductors, groin and buttock pain could indicate hip involvement of some kind. the posterior groin, tends to be more the posterior hip or low back. Stress fractures are rare, but it is possible that a femoral neck of pubic bone stress fracture can happen and can give rise to groin pain.

You need to look at the injury mechanism, it tends to be a high force but subtle injury and sometimes you get a sound like a pop in it, and the patient has to stop. So they couldn't keep on running, couldn't keep on doing what they were doing. If there is no acute pain or injury, look at the training history. If they have changed what they do, how they do it, the amount they do it, or the equipment they use; either shoes or, the weight training equipment anything that is if they change what they do.

And look at systemic change, ask for weight loss, fever, fatigue, recent infections because you can get synovitis or malignancies that in particular in younger people or people who have been traveling, that then can cause similar problems, so you should be aware of this.

Examination. You should look at the general hip movement. Find out the back mobility, find out what is affected. You are going to do palpation of the muscles in the region and you do testing for strengths and stability. You check their flexibility. You do a basic neurological examination. and then a palpation

of the groin itself. It is also important in these injuries to check for lower extremity problems, the knees, ankles and also low back because it can also refer to pain in the groin.

For investigation x-ray, MRI, and ultrasound are good but, again, you are going to try to find out what the problem is first, whether it is worth it. But they do say if there is an acute injury and you are suspecting any avulsions, growth plate injuries as well, it is a good idea to consider the MRI because you will see both soft tissue and can see the avulsions on that nicely as well.

Adductor-related groin injuries tend to be often of long-standing medial groin pain when patients come and see us. Often goes a bit down the medial thigh. Palpation gives sharp pain so does resisted adduction, so patients being supine with legs extended and then you do resisted adduction. If you suspect a tear or they are not responding to treatment, you could do an x-ray, MRI, ultrasound. I haven't really found any people with this where I wanted to do this, but you should be able to see the injuries on those types of imaging. Treatment is building up gradual strength in the hip and in the legs, to the dynamic stabilization of the pelvis. And we often find 6 to 12 weeks return to play if they follow the schedule.

Iliopsoas-related problems. Usually, patients would describe flexion and external rotation of the hip to be most painful. They find issues for sprinting and kicking. Often the pain is localized to the anterior groin. You will find pain on palpation of the lower abdomen, inferior inguinal ligament anterior hip pain, inferior inguinal ligament again in that area because their iliopsoas tendons go straight underneath it. Often, you will find pain on Thomas test, and decreased strength on ninety degrees hip flex. You put the patient in 90 degrees hip flexion and resist their flexion further. MRI or ultrasound scans are the main ones to show iliopsoas-related problems.

According to FIFA, on this one, there is no evidence-based treatment for this, but keeping up strength and stability in the pelvis and checking pelvic function, I, personally find that we need to look at low-back up to thoracolumbar junction at least because that is where the muscle attaches. So we need to look at everything that is around that iliopsoas muscle to make sure we get this good functioning as possible.

Inguinal-related problems. Patients often describe groin pain up more towards the abdomen or around the pubic tubercle. Many times you do not find pain on the adductor test, and often they will find pain and increased abdominal pressure. So coughing, sneezing, laughing. You often will find pain on palpation of the abdomen and the inguinal canal especially next to the bony attachment into the symphysis and the pubic bone. Always compare size because again patients can be tender on both sides with these types of things, especially this region because we have got the abdominal muscles inserted in there.

Investigation possible MRI or ultrasound. We had a basketball player a few years ago that came with us from having had the, he had had inguinal surgery and had inguinal hernia surgery on his left hip, and

he found that his right hip was playing up now. And we checked him out and he was tender around the area. We treated him just by loosening up the area, getting a better function in the pelvis, hips low-back, and the pain went away and they kept on coming back. So we sent him for an MRI scan. Unfortunately the MRI scan didn't show anything so we kept him going but then we thought something was wrong so we had another MRI scan and they found it on the second MRI scan. So MRI scans for some reason are not always very accurate on this, I don't know why, but I thought that was a bit strange. Treatment again is building up pelvic stability, But if symptoms are bad then, or if there is a hernia involved, which they don't like calling it anymore, then sometimes surgery to create better stability of the abdominal walls to prevent further problems is a good idea.

Pubic-related pain tends to be a central groin pain occasionally into the adductor region where they attach. It can be described sometimes as a diffused pain, often when you press on the symphysis pubis, you will find a localized tenderness in there. Rehabilitation, pelvic strength and stability is a good idea. It is quite common in kicking sports. That there can be radiological changes with no pain. You can get a little exostosis of the bone, you can see the bit of change of shape of the pubic symphysis, so you can have that without, without problems sometimes, so be aware of that.

Returning to play criteria for FIFA, they do say that groin pain is very common in many sports. The goal is to return the athlete to sport without putting them at risk of injury. So it is important to make sure that soft tissues and bones should have healed and should have normal gait ,full pain-free motion, full strength, muscle links within normal ranges, joint stability should be good and there should be no effusion of pain.

So this is what we need to go for, for most injuries, I think, not just groin-related pain. I found it difficult when you are working with sports teams that do not have the same amount of money as some of the big football clubs, that people want to get back early. So we have to be a bit careful to make sure that it is safe for them. So the goal is definitely to return the athletes without putting them at risk for injury. That is one thing we need to look for any injury that that athletes come to us with.

The phase they put for FIFA is phase one, you start when the athlete can weight bear. You do various sports, basic sports specific warm-up. So basically just keeping movement, keeping things going, getting things ready to use. Phase two, you will then increase the intensity of the exercises and increase the duration of the aerobic exercise. You will perform individual sports-specific movements, so there is no impact on any things, it is just the movements you are doing that fits within your sport. Phase three, we start off with individual and partner work. You increase to a 60-minute conditioning and increase in intensity and you do some interval work again, no contact yet. Phase four you start team drills. In football, it will be passing the ball, running, changing direction, and be these types of skills, but, no physical contact with other players for anything. Phase five is full practice in contact again, and they do recommend, which makes sense, to do a full sport cycle or event, simulated before you return to full competition. So warm-up friendly games, these types of things before you go in and you actually go full out.

Prevention: tends to show promising results on building strength of the hips especially the adductors and limit/managed to training volume especially during periods of rapid growth for the younger athletes.

We are going to go over some knee injuries now.

We are going to go over anterior cruciate ligament problems, medial collateral ligament, posterior cruciate ligament, the lateral collateral ligament, patellofemoral maltracking, patellar tendinopathy, patellar dislocation and Osgood-Schlatter.

For the ACL, one of the things with that is that often there is no significant trauma tends to be non-contact injury. Often it is twisting when the person lands, pivoting or decelerating that causes a problem, they would often describe a snapping or popping sensation. One of the main things for this is to show it tends to be an extensive, rapid swelling due to hemarthrosis because of the intra-articular origins and attachment of the ligament that does give a very large rapid swelling. The athletes often would describe it as a strong sense of something going out of place. You can have either of these, or you can have none of them. It is a bit of a mix but these tend to be the main things. Pain is variable, but the majority are either unable to or reluctant to weight bear straight after the injury.

We are going to show two injury mechanisms here. One of them is from football, in which we see one of the top English players at the time the World Cup collapsed. You see, he sits down, and he only passed the ball, there was nothing else that happened. We want to get that in a little bit of its closeup and then he gets the ball out, he lands, plants, foot twists, and gets pain. In basketball, see the point guard coming in here jumping up. You can see in a second, he jumps up, when he lands, looks at his left knee as he goes down, and gets ready to push up again, and how that affects the knee.

Slow-motion, there we go. So he jumps up, lands, twists, and then gets it there. So these are a couple of things where there is no impact involved.

Most useful tests for examination are Lachmans, anterior drawer and pivot shift. Always make sure you compare sides. Some people are looser than others, so it is nice to compare both sides. We are going to go over and show you these tests. and I will describe things as we go along because I do not know why there is no sound on these videos for you.

So Lachmans first of all, this is an Australian doctor, so I can't do the accent unfortunately. Just make sure the patient is relaxed, first of all, and then you hold up the tibia and then you are basically pulling the tibia forwards-backwards, and you are going to feel nice, strong end feel, no softness, mushiness at the end of that. So he says, sometimes, if people are a larger size, I would use two hands as well and stabilize it on your leg. So you are going to have a look now so he lift up and put his knee underneath the side to get a bit more control. You still get the tibia and everything nice and relaxed. Same movement, again making sure that there is a strong end feel to that.

For the anterior drawer test. You got the knee patient lying on supine, knee bent to a 90 degrees, and you tell the patient you got to sit on their foot to stabilize it, grab both hands underneath the tibial plateau, and you are doing an anterior pull. You want to be feeling a solid endpoint, you can do the posterior draw to see for the PCL at the same time in that position. As we said before, compare sides.

Pivot shift. For that one, it can be a bit of an issue sometimes when, if you get a lot of swelling, a lot of pain because they do not want you to do that. One of the things you are trying to reproduce is the kind of sensation that they got when it got damaged. So it could be a bit of that apprehension in it. So knee in extension, internal rotation, and then you are pushing the knee into flexion and hip into internal rotation. You often will feel a clunk or a pop or things with that, like, feel it a bit like what the person felt when they injured it. Now we are going to have a quick look at what it actually looks like, when somebody who has really got a torn ACL.

Just a quick check on the uninjured knee first. Now we are going to have a look at the injured knee, the same test as before, so you can see how that tibia just pops forward. There is just no solid end play, just this soft and moving. If you look at the knee, you can see how it pops when he is doing the pivot one. So have a look at this one goes from the subluxated position into its normal position when we are doing this. So that is what the positive tests will look like. Investigations for that tend to be x-rays, and AP lateral skyline and Rosenbourg. Views on AP are important to check for a Segond fracture, which is an avulsion of the lateral tibial plateau.

When you get an ACL injury, it is uncommon to have an isolated injury of the ACL the majority will also have other problems like meniscal injuries or bone bruising. So we need to check the different things. On the lateral view, check for an impact sulcus on the lateral femoral condyle, a type of compression fracture there. So we can not have any problems in MRI scans of course. They are very good at seeing any damage to the ligaments and tendons. Treatment, one thing to realize is that the ACL does not heal. Because it is an intra articular location, it does not heal and it does predispose to instability in the knee. So the key goal for treatment is to restore a sense of stability to the patient. Some people can manage very well without surgery especially if you are not doing a quick change of direction sports or high-impact sports. Often, you know, you can follow up and do a lot of stability work that can help it so you do not need surgery for that. The main indications for non-surgical management tends to be that the knee itself is stable. So it is not an unstable knee. So you have enough strength in there to protect yourself, that the patient has a desire to avoid the surgery, at least to start off with. That they are prepared to modify their activities to suit symptoms. So avoiding painful things, especially in the beginning. It suits the less physically active patients better, or patients who are likely to have a poor compliance with a post-surgical rehab because you need to do a lot of rehab to get mobility back and then to build up strength as well after the, after surgery.

Rehab, it is necessary to have a comprehensive program whether you have surgery or not. because you need to have that strength and stability in the knee to protect yourself.

You are very likely, if you return to play before you have built up adequate strength and your muscular control, to predispose the athletes for further instability. As we said before, you make sure that the chances of them having a recurring injury or being injured again. We do not want this. Generally, there tends to be four phases of rehab for ACL tears. Number one, you do a protected and controlled mobilization. So you can do work on the muscles you can do like an electrical stimulation of the quadriceps muscle and you want to try to reduce pain and swelling and restore as much movement as you can into the joint. Phase two is to control training, lower limb and core strength to make sure you stabilize everything around it. So that is not just for your quads, it is your hips, it is your core, it is making sure everything is getting strong and stable. Number three, you go into the more intensive training, start to include sports specific training, your muscular retraining. Bit of impact works everything in sync and phase four, you are doing a return to play where you are again having, preferably some personal trial events before you go all out.

**Meniscal injuries**, this is one of the very common injuries. and some research shows up to 15% of all sports injuries are meniscal damage. FIFA says that 8% of all football injuries are meniscal. 70% of these tend to be the medial meniscus. It is important to have healthy articular cartilage for optimal function in the knee joint. and damage of course can affect the athletes ability to compete and also predispose for other joint degeneration. So possibly osteoarthritis/degenerative changes in the knee. Sometimes, meniscal tears can spontaneously heal, especially the small longitudinal stable and asymptomatic ones. We have three zones in the knee cartilage; red-red, red-white, and white-white. That indicates the amount of vascularity you have in there. And again, if the tears are in the peripheral 10 to 25%, where you have the vascularization, the red-red or the red-white zones, the healing tends to be a lot better. If the patient comes in with a locked knee, so they can not extend it; particularly it tends to lock and cannot straighten it again, it is worth to look a bit deeper because it is often an unstable tear that goes across several zones and could possibly do with a surgical repair.

Problems tend to be high in females, older athletes and athletes with a history of previous knee injuries. We often see condral injuries and meniscal tears in association with knee ligament injuries or patellar dislocation. So it is important we check for these at the same time. 75% of athletes who have not had surgery will return to high-impact activity. It is not something that is career-stopping for most people. Tends to be happening from a shearing injury or high compressive loads with twisting often in that as well. So tackling, landing after jumping, kicking to the knee. Quite a few things can tend to cause problems; like rapid repetitive stepping or squatting on an uneven surface. These types of things. In younger athletes, it is often caused by a traumatic injury. Pain that seems to be intermittent usually occurs with weight-bearing, squatting, twisting or cutting movements. and if it is a medial meniscus, which is most common, it is usually localized to the medial joint space and if it is the lateral it tends to the lateral joint space. You can have a displaced bucket handle tear that can cause proper locking of the knee where you can not move it. If the knee is giving way without warning, it can be a sign of an unstable meniscal tear. If we get people to have an MRI scan, we can often pick that up on those but not always properly. Examination first of all, is looking for effusion swelling, checking the movement,

palpating the joint space for tenderness, which is one of the most accurate tests actually 64 to 6-74% accurate. Then you have some tests that are specific but not that sensitive; Thessalys, McMurrays and Grind, so we are going to go over at least one or two of these. Thessalys the first one which is the one that they said was the most accurate test in the past for detecting meniscal tears, but then that has been shown in newer research that it does not really better than any of the other ones. But it is good to put them together with the different tests with the findings as well.

The research shows that all the tests are equally sensitive and not very specific. The first thing you do is you check the unaffected leg, because you want to make sure you have a baseline to check the other one. Then the point is that you stabilize a patient, get them to bend the knee to about 20 degrees and twist three times each side. Positive test will be pain or clicking and popping in the knee. McMurray's test, which we probably know from before is supine in patients, flex the knee, valgus stress in on the knee and external rotation of the foot moving in and out to feel for any clicking and popping. You will move the leg from flexion into extension and you feel for popping or pain.

The grind test is having the patient lying prone, bend the knee to 90 degrees, stabilize the femur with a bit of a pressure from top to bottom through the tibia and do internal-external rotation, again to check for popping or pain. So neither of these tests are shown to be really specific, but added together, they give up about, you know, a pretty decent specificity adding everything together with history taking. Investigation of choice tends to be an MRI scan, especially after trauma. That could also then identify any associated ligament injuries or bone bruising which often happens if with an acute tear particularly. Looking here, we can see again, nice meniscus here lateral meniscus and you coming in here. I can not see that because all the people involved, but he can see, you can see the lift up here where there is a damage into the, you can see it is nice and smooth the meniscus here you have got that little bit of a white line a bit of damage through the meniscus. Treatment; rehabilitation tends to start off with avoiding or decreasing activities causing pain, building up strength, endurance and proprioception for the whole lower limb including the core. For younger athletes, or if there is any instability often meniscal repairs the way forward. The old arthroscopic way where they actually trim off the cartilage, cut it off has shown to increase stresses into the knee joint and promote early degenerative changes. So often a meniscal repair is the way forward. The success rate, according to a consultant I spoke to, is around 60%. so it is not massive, really good for the bigger tears, but it seems to work quite well for the smaller tears and the younger you are the better it works. Research is still looking at protein-rich plasma injections whether that can increase healing.

The medial collateral ligament is the most commonly injured ligament in the knee. It goes all across the medial aspect of the knee. Injury seems to be primarily due to an acute valgus stress on a partially flexed knee. So we tend to give you an acute onset of localized medial joint pain, occasionally with swelling around it as well. Examination; You grade the tear depending on the degree of laxity present with the valgus stress.

So you assess it both in 30 degree flexion and in full extension. Grade one is a mild localized tenderness. grade two is a moderate grade where you see a bit of laxity on valgus stress within 30 degree flexion. but a distinct endpoint so it doesn't have the soft feel and there is no laxity in full extension. Grade three sprain is more serious and the amount of tenderness can vary a bit, but you have laxity in 30 degree flexion and in full extension as well. Treatment tends to be conservative. For grade one it settles quickly. Just the movement and isometric exercises. Sometimes you can put some tape on it for stability and comfort, two weeks return to play. Grade two to three can take 8 to 12 weeks to return to play depending on severity. Occasionally according to FIFA, for this one, it is a good idea to brace them to prevent the final 30 degrees extension early on, for the first week to two weeks, especially if there is quite a bit of instability there just to get rid of the rotation and the pain so they can return to training.

The PCL (posterior cruciate ligament) is much stiffer and wider than the ACL. The main function is to prevent posterior translation of tibia, but it also re-restrains tibial external rotation and both varus and valgus stresses. The history that people come and complain of is often a high-energy trauma. So fall on a flexed knee, hit the dashboard in a road traffic accident so it needs a lot more power, but it can also happen on a hyperextension or hyperflexion injury. Usually there is no popping or snapping or significant swelling with this. It is not the ligament that is in the knee joint the way that the ACL is and affects that. Tests are the posterior drawer and the posterior sag. So I think we got a posterior cruciate ligament examination here. We are going to go over that and explain. First we are going to have a look at the same Mark Fulcher here from the FIFA medical network. So if you want to look at these videos, look on YouTube channel FIFA medical network, going on to videos, and you can see this. So again, we do the same as before the anterior drawer, knee flexed 90 degrees, sit on the foot to stabilize it and push back. And again, you are feeling for a solid end feel. So there should not be any give, it should be solid, you should stop and lock. So the posterior side puts both knees next to each other. And you are looking across where you got the tibial tuberosity is what we can see them sticking up. And you are going to make sure that they are about the same and that it doesn't sag down under on one leg, which is a typical sign of a PCL tear. Then we are going to do this on a person with actual problems. So check for the laxity sideways. Then we lift it up and you can see that sag where you can see that hyperextension in there. we see it better with both legs up together. But you can really see how -that tibia sags backwards because there is no stability in it. Treatment; if you only have the PCL involvement, it usually does very well and doesn't need surgery because it gets stable quite well.

The functional outcome does depend on the amount of laxity present. Rehab seems to be one of the main things; strengthening the quads to restrict the posterior translation, and usually return to play is six to eight weeks. So it is one of those that responds well, if there is no other damage, to conservative treatment.

Lateral collateral ligament is rarely injured in isolation. it does tend to happen with multi-ligamentous injuries in knees, it is something we have to be extra careful with. there tends to be varus and

hyperextension injury. But it can also happen to an AP blow to the tibia while the knee is an extension, so full extension injury. Examination has to be comprehensive. Because there are several structures involved in it, you often get the posterior corner and everything else involved in it. So you do the hyperextension test, the laxity in flexion, dial test, posterior drawer test. So we'll skip through these as well. So we take the knee into extension, and you do varus stress with 30 degree flexion and extension to check. So again, same thing as before if there is laxity and extension, you see more serious injury. So if we suspect a bit of a more serious injury and we expect the posterolateral corner to be involved, you do the dial test, which is lying on the back, knees flexed to 45 degrees to external rotation to start off with and check if it is the same or different. Take it off to 90 degree flexion and do the same thing. Often, if it is in 45 degrees, it tends to be the posterolateral corner injury and if you get pain with 90 degree flexion there is often a PCL injury involved as well.

Treatment; if there is no laxity, laxity in the, in the ligament, conservative treatment; strength, proprioception and function is enough. If there is laxity, the FIFA says that you should consider an acute repair because there can be a lot of other involved structures. So it is important to make sure that everything gets looked at.

Patellofemoral knee pain; it is very common to get anterior knee pain like patellofemoral. There are two main groups: normal knee group and structural changes. So younger adults tend to be structurally normal but have functional issues: weakness, increased training loads, this type of thing. As you get older it tends to be more due to the pathology; cartilage pathology or wear and tear in the knee.

History is often a diffused poorly localized anterior knee pain that felt deep inside the knee. Usually of an insidious onset. so something that slowly, gradually happens but it can be caused by falling into the knee. Tends to be made worse from walking or running; particularly downhill or downstairs. But it can get a clicking or catching sensation but it doesn't usually lock the knee. Quick examination of the patellofemoral joint. So one of things you do is you get people standing on one leg you- you do squat, and you make sure you are checking that they are stable from the pelvis down, you make sure that the knee doesn't move in or out. Seeing the wobble is one of the things that you see a lot when there is instability in there, which is one of the parts of that (Patellofemoral maltracking). Other things we look for, we put the knee in very slight flexion. And we basically, push the patella medially, from lateral to medial and you are moving the knee up and down and you do that in different directions you push down on the kneecap, anterior to posterior to check if there is any pain or any grating.

The main thing to do is to make sure that it reproduces a patient's problems, and that there is a difference from side to side to show. Let us say in chronic cases where the pain does not go away again, sometimes in x-ray and MRI check if there are any chondral/osteochondral injuries.

Treatment, there is not really any proven treatment. The aim is to restore normal soft tissue balance of the patella and mobilize lateral structures, to strengthen the vastus medialis and the proximal chain, especially around the hip extensors, hip external rotation and the abdominal wall. I found dynamic

tape or sometimes kinesio tape can help especially in earlier stages to to offload some of the pressure, some of the strain for the athletes.

Patellar tendinopathies: infrapatellar is the most common one. and then suprapatellar. Those are two main issues when it comes to patellar tendinopathies. The patient tends to describe a generally well localized anterior knee pain, usually increased by jumping, bounding and hopping. Usually have a gradual insidious onset, you can sometimes experience an acute tearing sensation, but for most people it is something that happens gradually. It tends to get better with warm-ups but get increased stiffness or pain either after activity or next day. Again, we were told that, you got to be a bit aware of, if there is an acute sudden onset of popping and snapping especially those major bruising around the kneecap because you can get a tendon rupture of the infrapatellar tendon or supra patellar tendon or a partial rupture, so something to keep an eye of on as well.

Ultrasound scan is the best modality for that, usually. Treatment, eccentric exercises are advised, just make sure that patients know that they can be painful to do. generally tend to be more suitable for chronic cases and it is something you need to do lots of repetitions of, it is something that takes quite a bit of time.

Knees strapping or taping has shown variable effect but again I found particularly dynamic tape seems to be a good way to offload this and that 60 to 80% of athletes return to the previous level of support. Manual therapies tend to be mainly cross friction and soft tissue mobilizations. Shockwave treatment has shown to be of some help with it. Getting people on hydrotherapy on the OG treadmills at the early stages seems to work nicely for patellar tendinopathies as well.

Prevention; careful management of training, and then if symptoms come back, reduce the training load or maximal loading as well. Isometric strength afterwards to build up stability around the knee.

Patellar dislocations, it is usually quite easy to see when it happens. Usually follows a twisting injury with the foot planted. So pushing the kneecap, usually, laterally and you can get it from a blow to the knee as well. Many times the patella relocates itself as athletes straighten the knee, so it is important to ask them about these questions: what exactly happened when the injury happened.

So the first thing you should try to do is always to relocate the kneecap into the trochlear groove. Treatment, sometimes a short immobilization is recommended. But keeping it mobile, keeping it moving and then building up isometric strength to the legs and hips, in order to help prevent this happening again.

The difference between professional football players when this happens, so nice little patella dislocation here. And again, what we are doing for relocating it, is a slow extension of the knee. When you get to that point, the kneecap will usually always pop back in place again. So, here we go, here we go, back in place. If you are looking at ladies football, you know, sometimes people have to do things

themselves to try to get it back in place. Again, not the same medical help here but maybe women are tougher than men, I don't know. So let's just see it a bit closer. Again, off to the side, medial push, kneecap goes off. And again, trying to get it back in place herself still, the pain afterwards.

Osgood Schlatter is quite a common thing for the younger adolescent athletes, more common in boys than girls, and it is estimated that 20% of children will have this at one stage. It is often associated with sports with a lot of running and jumping. It tends to happen from 11 to 15 years of age. And usually the patient will complain of a very localized pain around the tibial tuberosity, aggravated by exercise and pain. One thing to be aware of, is that pain that does not get better with rest, not using it or that is present at rest, is not consistent with this diagnosis and you need to have things looked at a lot more seriously in that case. Often, there is a point-tenderness on the tibial tuberosity, local swelling, and then there shouldn't really be any other issues on a knee exam. X-ray, very good for this, you can see that well in the picture and the vast majority of case findings are normal, even if there are some extra large tuberosities, or a bit of a fragmentation. The Apophysis can develop from multiple centers and it can look like a fragmentation, so you should put it together with the tenderness and how the patient described the problem.

Treatment, it is usually self-limiting, goes away on its own, and will settle at the time when the tubercle is, sorry the apophysis has fused onto the tubercle. The symptoms may persist for a couple of years, and again, it is education, it is listening to the problem. So any activity modification that is needed when there is pain you do but there is no need for complete rest. Reducing the number of training sessions or overall sports involvement is usually enough to get rid of the pain.

### **Change of speaker**

**Pete:** As we hit further south, we are going to jump straight down to the ankle initially and look at sprains now, this is something that most of you will have seen in clinic whether you are heavily involved in sports practice or just regular practice. In fact, many of you will have had these yourselves, within a sprain around the ankle, commonly we will see an inversion sprain, eversion sprain, or what is commonly called a high ankle sprain, or a syndesmosis tear. The inversion sprain being the most common, in fact, it is the most common sporting injury we see. So, ankle sprains whilst most people will get up and jog them off and consider they are simply a moment during a game or an event, we do see ongoing problems that occur as result of ankle sprains. Decreased hip abductor strength a decrease or a change in ankle range of motion, this study spoke very much about the decrease in ankle motion a paper this year by Moisan, had a look at people with chronic ankle instability and found that on heel strike during landing, there was an increase in inversion. We are seeing people with an inversion sprain, actually addressing the ground rather than a neutral position actually closer to rolling their ankle from the start. Be aware that whilst there is a high incidence of recurrence here, Part of it is a biomechanical issue where they have actually started their stride in the level of inversion that is higher than the regular population. Obviously, balance decreases.

Sporting performance is a really interesting one, this paper in 2011, based in China, we may have a look at the level of the various athletes and their history of ankle sprains. What they found was that the higher the level of the athlete, the less ankle sprains they had. So there is a strong correlation between the number of ankle sprains, severity of the ankle sprains and the level of sport the people achieved. The really interesting thing about the study, is that it looked at sports from soccer or football, through to basketball, table tennis, they also included swimming. So even the non-ground athletes you might say, might have an implication to their performance, following ankle sprains. It is certainly an important injury for us to be having a look at and see what we can do from a management perspective. Obviously, with recurrent sprains, one of the implications there is time out of sport. When we have a look at the structures around the ankle, just to give you a little bit to orientation you a little bit, number five and number six here, are anterior talofibular ligament. We have got a superior and an inferior band, it is a very strong ligament, and it needs to be, because it is looking to hold the talus back into that mortise joint. Another important one for the inversion sprain is the calcaneofibular ligament number 10. These are all quite robust, ligaments and the calcaneofibular we will see as part of our assessment shortly. When we rotate around to the back of the ankle, we see our posterior talofibular here, number six, again, quite a robust ligament, holding that talus in place within the mortise joint. Now the Talar Tilt test is one of the ones that we can do when assessing the ankle.

## **WATCH VIDEO**

The sound is not great. We are looking at damage to the anterior talofibular and calcaneal fibular ligament. This ankle here that is testing is a sound ankle. You will see that if there is a limitation as it goes into inversion but what you will also see is that line come up, which is the calcaneal fibular ligament, with those, the peroneal tendon around it. When it switches over to the other side, this is the injured side and you will notice as he takes the calcaneus medially, there is no calcaneal fibular ligament come up so we have damage to that one and increase range of motion there. This is where we are suspecting injury on this side. Now be aware that it is good that the calcaneo fibular ligament is one of their indicators there. You are comparing side to side, but this is a common injury, so we might see athletes with the injury on both sides.

## **WATCH VIDEO**

Alright, the anterior drawer is another one that we look at here for assessing the ankle. The anterior drawer really does rely on comparison to the opposite side. So, be aware that unless you are familiar with checking a lot of athletes here, that you may very well be looking at false positives, if you have got someone with high movement availability.

So now I am just pulling the calcaneus forward and looking for the amount of laxity that might be there. It is highly reliant on the other side. So just be aware of that when you are using that particular test. As I showed you before, we have got the ligaments there, and these appear to be the main focus of the assessment and also treatment of an ankle sprain. We focus on the inversion sprain here. We see in

the picture on the left, the ankle goes over, we see that drive or force down through the fibula look and tearing of those ligaments. On the right hand side though, is something that you all should all be very familiar with just very basic anatomy. When we have a force down over this joint here, these two bones are the same two bones up here. So recognize there are implications at the proximal tibial fibula joint implications at the tibial femoral joint. Because as we go into inversion, the normal coupling of inversion is with tibial external rotation. We have a rapid external rotation of the tibia in relation to the femur. So quite often, what you will find post ankle sprain of an inversion sprain, is you are going to have joint restrictions within that range of motion at the tibia femoral joint, the proximal tibia fibula joint, as well as what you find down here, with the talus and its relationship in the mortise joint and also in relation to the calcaneus. So be aware that as a sports chiropractor, these are areas where you can certainly have an impact on helping with the biomechanics of these patients post ankle sprain, that you need to be having a look at the whole system here. Try not to be myopic and be focused on repairing, pandering to just pain that is down here. The whole system we need to be aware of and ideally we need your hands on some ankles and legs, you will be looking at those types of techniques as well.

What we have, look medially, so eversion sprain, what is commonly termed the deltoid ligament is this collection of ligaments on the medial side of the ankle. The tibio-navicular ligament, a tibio-spring ligament. This is a ligament that has an attachment, which is a soft tissue attachment at the other end. So runs from the tibia and then down to the spring ligament, the spring ligament complex itself is part of the deltoid ligament complex. Where the tibial calcaneal ligament, and the deep posterior tibio-talar ligament. Now, this does not show the anterior tibial tunnel ligament or the superficial posterior tibial tunnel ligament. That is because in some people, they are actually not even there. So be aware that your primary ligament are the ones shown here. The others exist in some patients, not all. We have to look at a dissection here and get to an awareness of how they look in situ and also how big these ligaments are.

We move on to the high ankle sprain syndesmosis injury. These are really important one to be able to identify. Quite often they are not considered until somebody is not resolving from a regular inversion or eversion sprain, they can occur in either. Big thing with your syndesmosis injuries is that whether it is inversion or eversion there is generally a significant dorsiflexion or plantar flexion movement. What happens in both of those, and probably more commonly the dorsiflexion is we see the talus pushed up into the mortise joint separating that tibia and fibula. That is where we get the tearing of the syndesmosis. Three main ligaments through there, and it can be one, two or three of those that tear within the syndesmosis injury.

So, when we are looking at these athletes, you will generally see less swelling in it specifically the dorsiflexion injury. You need to be palpating the tibia and fibula to rule out any fractures, the anterior joint line is going to be tender. You will feel up between the tibia and fibula. Now be aware that when you are looking anteriorly at an ankle. If the pain is low, you may be looking at a talar dome fracture. If

the pain is above where the talus is then that is the area that we are considering for a syndesmosis injury.

The squeeze test is where we squeeze above the mid-calf so essentially what we are doing here is as we squeeze the tibia and fibula high, we are creating separation low. That will disrupt those torn fibers. The Kleiger's test we are going to have a look at the moment. These patients will also have trouble pushing off or doing a heel raise. But you also want to be checking out their neurovascular status to rule out compartment syndrome, which we will go into a little bit later in the talk as well. So, here is the Kleiger's test.

### **WATCH VIDEO – problems with sound**

Okay, so he is dorsiflexed, and externally rotated. As he dorsiflexes he is pushing the talus up into that mortise joint, and the patient's going to be in a lot of pain up in between the tibia and fibula, when you are doing that dorsiflexion and external rotation. With that particular test, you want to be aware of their functional capacity. With that, there is going to be a lot of pain when you are doing the dorsiflexion. We will just roll that again. You will see where we get up to this part, as he stabilizes the tibia and fibula, he is then going to bring that ankle up into external rotation and dorsiflexion. So that is where the patient's going to give you a bit of a scream. So be aware that it could be painful. Warn the patient that it could be painful, as you are jamming that talus up, looking to separate the tibia and fibula. With these disrupted fibers there, you will often have some left intact, which is obviously what is going to create the pain, and so be aware of where that is at, how long it has been there and you can get onto that early bracing can be useful, but if not, it quite often can go to surgery.

So, moving on from a sprain, looking at fractures, three main types of fracture we are looking at the lower limb are our direct trauma, avulsions, and stress fractures.

The direct trauma ones are pretty obvious. There is an incident involved, there is significant localized pain and generally is trouble weight-bearing after those fractures. One of those is a Lisfranc injury. Now, when we are looking at this particular injury, the Lisfranc joint complex is actually the whole of the tarso-metatarsal row, and so you can see it covered here in gray, that is the area that we are talking about. It is, because that works as a unit, and we can see various types of injuries can occur there. So, as you will see on the diagram here on the left, the actual Lisfranc ligament runs from the medial cuneiform across to the second metatarsal. The second metatarsal sits up in the joint here in between the medial cuneiform, the intermediate cuneiform and the lateral cuneiform. It acts like a keystone in between these. Any disruption to that level there can create any number of shifts or dislocations of the foot, and it makes the Lisfranc injury quite a significant one. Only in the last couple of years, one of the top Australian football players ended his career, because of a Lisfranc injury. See on the right-hand side, one of the mechanisms which will be coming down onto the ball of the foot, which drives that cuneiform down and pushes the metatarsals forward and that is where we get the disruption of the

ligament. On X-ray we see on the right there that classic separation between that first column and second column, so our medial and intermediate column within the foot.

Because of the strength in that part of the foot it is quite often a high-speed injuries such as motor vehicle accident or skiing, but can be simply twisting of the foot on a fall or landing on the foot and so you will see some people get these from a relatively innocuous injury, particularly off the sporting field. When they are on the sporting field, it might be a change of direction, type injury that you will see, and they will get pain in the midfoot, there will be pain lifting the heel off the ground again. The pain is really across the top of the foot, bruising under the foot is a classic one, they give you some suspicion, now particularly early bruising under the foot. Obviously, if somebody has had their foot down with any sort of lower limb injury, we can see settling of blood which starts to drop the foot and toes, but you will see distinct bruising in the arch of the foot with the Lisfranc injury. They will have trouble walking and balancing.

So, we see a picture here. We have got the fracture there of that second metatarsal where the ligaments are involved. and on in diagram B, we see that classic bruising through the arch of the foot that occurs with the Lisfranc injury. When you see that pattern, you see, as a normal blood flowing down as where it falls around the toes, but that classic distinct bruising through that arch is one thing that might make us suspicious of Lisfranc certainly we will get these people off for an x-ray early.

Looking at the avulsion fractures in the lower limb distal fibula is a common one with an inversion ankle sprain. You want to be looking for a very specific pain at the lateral malleolus, and that will certainly be quite distinct on palpation. Be aware that you may have torn ligaments there but generally that is going to be in that ligaments space in between the fibula and the talus.

The proximal fifth metatarsal is the next place where we will often see or more commonly seen avulsion fracture. So, when we are looking at the fifth metatarsal, it is important to recognize where the fractures are that we are looking at. When we look close to the base, this light blue area is where we are going to see avulsion injuries. The Jones fractures in the dark blue area, stress fractures occur in that diaphysis in the red, then shaft and head fractures which are more likely a direct trauma occur further down the fifth metatarsal. Zone one, which is our avulsion area, quite often causes a twisting injury, when the rear foot gets into inversion during plantar flexion. Think basketball, volleyball, someone has landed awkwardly or landed on someone else's foot after a jump. This is where there will often be sudden pain at the lateral part of the foot, and we are thinking of avulsion injury there. Zone two, which is our Jones fracture. Now with this area here, it is a significant adduction of the foot with a raised heel, so change of direction. Probably the first one of these that I saw was at an indoor soccer match or futsal, and yet very obvious when you saw this kid was in any enormous amount of pain.

Various football codes with fast changing directions use netball and a hard court and frisbee you might sometimes see these, and they can involve the fourth, as well as the fifth metatarsal articulation. We have high non-union right here so just be aware of a fracture, again X-ray early, I want to say early,

there might need to be a day or two before it will come up if it is a fairly close fracture, but be aware of that one. With the non-union one, one of the reasons for that is not dissimilar to the scaphoid, we have a blood supply that goes past and then comes back up into the proximal end of the fifth metatarsal. Zone three so we are going to stress fractures through this area where we are thinking runners, others that have accumulated repetitive load in high volumes. But we also see dancers' fractures or spiral fractures come up with fifth metatarsal on here as well, pretty nasty, you are going to know those pretty quickly, they are in a lot of pain.

They are going to be painful on palpation regardless of where they are, there is going to be pain with weight bearing. So, what we are seeing in the x-ray here on the left-hand side is the Jones fracture. This is the one where we need to be very aware that the blood supply is coming and passing and then coming back up into the base of the fifth metatarsal and we may see non-union there. One of your big tests if you are needing to do further tests for a fifth metatarsal fracture is resisted eversion, they are going to screen pretty quickly.

So with our management from the zone perspective, we have zone one nondisplaced, generally we are going to be looking to manage that conservatively. Just get them into a boot, or even a hard sole shoe can be good enough. They are just protecting that against that further twisting motion of the rear foot. When we are looking at our nondisplaced Jones fracture, it is possible to look at conservative management but if you are dealing with a high-level athlete, most of these athletes are going to go for surgery early on. Rather than waiting 6 to 8 weeks of actual non-weight-bearing, to then see whether there has been malunion they will be in there, get it operated on and get it pinned, so they can get back to their sport and there is a more definitive time to get them back to their sport. When we are looking at stress fractures in zone three, be aware that some of the recovery times of these particular stress fractures can be up to 20 weeks. This is why, and I'll talk about stress fractures in a moment, we need to be really aware of what is happening with those, and again, early diagnosis so we can start management with these athletes, so their time off the field is not dramatic. In 20 weeks, if you consider an athlete that might have got a fifth metatarsal stress fracture, that was looking at this sort of management, anytime in the last 6 months, their chances at the Olympics are gone. Therefore, we need to be aware of these injuries and be managing them early on. I am looking at stress fracture presentations, as I said earlier, it is generally a repetitive activity. Running is probably the most common because the repetitions within running are obviously very high and multiple body loads at a time. There is usually a gradual increase in symptoms, and you will see these are most commonly in elite athletes because they want to continue pushing, they accept a certain amount of pain with their training. So you see this gradual build up by the time they come to you, it is quite often "I have been getting pain for a little while, it just does not seem to go away or worse now, it is impacting my ability". When we are looking at our particularly our metatarsal stress fractures. This is going to be the athlete that is running up hills that is saying "This is really starting to hurt" our sprinters on their take offs. There is always going to be very specific tenderness to touch, but consider that a stress fracture or stress

reaction is a continuum. This is a really important part of our job as a sports chiropractor when we are looking at not only diagnosing but managing these as well.

When we look at incidence of stress fractures in the lower limb, our high risk here and this is from a football study, certainly, includes runners within that but your high-risk areas your femoral neck, anterior tibia, medial malleolus, lateral process of the talus, navicular, that fifth metatarsal again base at the second metatarsal, and we saw where that sits within those cuneiforms, then the sesamoids under the big toe. Lower risk but also obviously occurs in the postero-medial tibia, fibula. I had a runner with a fibula stress fracture, probably nine months ago. We got her back to running fairly well, but that required quite an extensive period of management of her biomechanics as well as her training load. Femoral shaft is really unusual, pelvis you get those from time to time, particularly in your longer distance runners, Calcaneus I have not seen one of those.

Second to fourth metatarsals, probably even more so in the younger population that I have seen those injuries, basketballers quite a bit. Quite often again, there is an inappropriate loading going on within their movement patterns. Look at the bone stress continuum, bone loading is normal, bone strain is also normal, but it is after the bone strain that we start to see the divergence. On the right-hand side of this continuum we see no damage, strain related re-modelling and a positive feedback into our bone loading continuum. This is where bones get stronger. It is the normal part of bone-strengthening, to actually have load and strain on them. It is when we go down the bone damage path we start to consider, is this athlete going to move forward or backwards? We get damage-related remodelling so we might get a callus formation on the bone, and that is where, if we go into damage, from their damage repair, we have the altered skeletal properties on the left-hand side here. It can be a positive feedback and strengthening that area, even though it is not the normal standard bone-strengthening pattern, but when we go into the right hand here, where we start to get that imbalance between damage and remodelling. The body is not keeping up with the amount of damage that is being done. This is where recovery times are super important. The accumulation of damage starts to create a stress reaction, the stress reaction turns into a stress fracture, and potentially a complete bone fracture. So as those last three there or last four where we need to be super aware of these athletes, how we are managing them, and what we are doing with their bodies, to help them stay in their sport. Because this is where you can turn a short injury into a long injury very easily with poor management. That is also where we need discussions with the coach. Now, I am a big fan of his picture when I came across it from the Hamstra-Wright paper and the reference will be in the reference list later. One of the things that we most commonly see when people come across stress fractures in the lower limb is the bottom green one here and extrinsic factors, and that is training load. Everything is about training load. I must have been overtraining, too many miles, and quite often we will see stress reactions, stress fractures. When we are looking at the factors that might be influencing the stress fracture, consider that training loads only one of them. Have a look at the rest of the things with this. We have got nonmodifiable factors sex, race, age, genetics, alignment, prior injury. We are starting to see studies now suggest that gut health might be important as far as how our body is managing that remodelling that recovery

process. We might be needing to bring in a sports nutritionist, which is a common one, we see stress fractures keep coming up. But also recognize that we need to be looking at the biomechanics. That is our area of strength. We need to be having to look at why these stress fractures are occurring where they occur.

One of the things that is often ignored with a patient with stress fractures when everyone is focused on the training load is that they forget, there is a reason why the stress reaction occurred at that point. This is where I get a little frustrated when overtraining is blamed all the time. The runner who comes in with the tibial stress fracture on the left-hand side. Well, that is great, your train load has increased, which may have brought that to the fore, but why is it the left tibia? It turns out that the left leg did not do any more running than the right leg. Recognizing there must be a loading or a mal-loading effect that is creating this differentiation between damage and repair, on the left-hand side, that is not occurring on the right hand side, and that is occurring in the tibia and is not occurring in the metatarsals or in the navicular, which are other areas that we know are subject to stress reactions. So why is it occurring there? What is happening around that area that may be offloading and what is happening on the other side? Classic one that I saw a number of years ago now was a patient who had these recurrent stress fractures on the left-hand side, and he had fibula stress fractures and he had tibial stress fractures; he had femoral neck stress fractures; he had fifth metatarsal stress fractures. When we had a look at his movement, one of the first things I picked up in a very basic examination was he had issues with his right ankle. He had previous ankle inversion sprains. He was not loading fully through the right-hand side, so his left side was actually doing all the work. Now, he was not even a track runner. So this athlete was doing mostly long-distance runs, off-road on-road, varying surfaces doing all the right things there. There was this constant focus on what is wrong with these weak left-hand side. Left-hand side was a strong side. It was a side that was having to make up for a right side that was not actually carrying its weight. We need to be super aware of why the actual stress or the load going to that point, and what areas might not be taking their load, and quite frankly, as chiropractors we have really well placed to be checking that out all. So recognize your strength in helping manage stress reactions, stress fractures, it is not just about the training load. We have a significant part to play within a team when we are managing these but make sure you are getting other people on board, talking to the coach, talking to nutritionists, and not just dismissing these as an overtraining injury.

We have a look at common tendon injuries in the lower limb, our achilles pops up. Thomas spoke earlier about the patellar tendinopathies. With achilles we have got tendinopathies, and ruptured peroneal tendon we can see tendinopathies, and a subluxing peroneal tendon there as well, which is probably more common.

Subluxing peroneal tendon, you will get a ruptured superior peroneal retinaculum. Commonly associated with recurrent inversion ankle sprains, the athlete will feel a pop or flick, with a sense of pain, or instability behind the lateral malleolus. So doing a resisted dorsiflexion, eversion, we will

actually see that tendon pop out, it will be quite obvious. You can try them initially with a boot because essentially, to get that to heal it means just not having it not happen again. If it does not happen again, then there is a chance that that peroneal retinaculum can heal. But otherwise surgical intervention is generally fairly simple. The recovery is quite fast, I have had a couple patients go through that in the last six months, and they come back, feeling good and performing well afterwards. In number 8, we see the peroneal retinaculum superior peroneal retinaculum which is where the subluxing of that tendon will occur. If you have something that dislocates behind their ankle, it will be that peroneal tendon.

Our achilles tendon rupture, these are pretty dramatic. You will often hear a loud crack or a pop. Some people say it sounds like gunshots going off. Quite often the patient will turn around to see who has just kicked them or hit them in the back of their leg, and there is no one there.

More common in older athletes, we can look at surgical vs conservative management there. In recent years, conservative management has certainly been given a lot more airtime. With conservative management, what we initially thought was that it depends a lot on the amount of separation. It is actually more about how quickly you can actually get these people into a boot afterwards. Older style management was about having them in a boot for 6 to 8 weeks without any movement, which is, you know, part of what they do post-surgery, but they're slowly starting to increase the pressure on the tendons post-surgery. What we are seeing more recently is that 3 weeks of strict bracing, and then moving into a movement restrictive brace, where they are able to get some movement happening, it gets a better response to their conservative patients. It is certainly something to consider, depending on the level of your athlete, what their return time might be.

When we are looking at assessing an achilles rupture let us have a look at this video for the assessment.

**WATCH VIDEO THOMPSON TEST** - You see that there is no real movement through the foot there. The light movement that you see there is actually the long flexes of the toes. Generally speaking, as you move through, we should see movement of the foot. But obviously none there when we have got that complete rupture.

We are looking at achilles tendinopathy, you will see these often. It is a gradual onset, there will be pain and swelling around the achilles. Again, it is often going to be associated with a sudden increase in training intensity or duration, and we are well placed to manage these conservatively. There has been plenty of talk in the past about eccentric exercises, isometric exercises, and generally, a mixture of the two I find is going to get a good result with these. But also have a look at why it was that particular achilles that might have been aggravated. Why was it taking the load? When we are starting to look at those sorts of features around an achilles tendinopathy rather than just beating up the achilles that might be sore, we need to look to the structure for some of those clues to how we managed it.

Now, on the left-hand side here, you will see a diagram from a 2004 paper, I believe it was, where they actually talk about a rotation of the fibers of the achilles tendon for around about 15 centimeters (12-15 centimeters) from its attachment to the calcaneus, where we start to get a rotation medially with those fibres. The achilles tendon actually has a role in supinating and inverting the foot, which helps with propulsion from that propulsive moment, not just the plantar flexion of the foot. We are looking at driving into that big toe, driving into that medial column where we get all of our strength in propulsion. The achilles tendon, the shape of it starts to do that. Maybe we need to have a look at, are there other muscles involved in supination or internal rotation of the foot, that may be weak that the achilles is starting to make up for?

We have to look on the right-hand side of the picture here. A wonderful picture of demonstrating achilles tendon, whilst we talked about attachment points of the calcaneus. It actually wraps around the calcaneus and continues into the plantar fascia of the foot. We should consider that our calcaneus is to the calf muscle, what the patella is to the quadriceps. When we are looking at injuries around the knee, we are certainly looking at the infra-patella tendon and its relation to the patella and from the patella up into the quadriceps itself. The calcaneus plays a similar role in allowing the calf muscle or the tricep surae to exert force around a corner. We need to be aware of structures into the foot when we are looking at what might have been creating issues as far as mal-loading of the Achilles tendon, and are we considering the plantar side of the foot, the extensibility of the plantar fascia, the strength of the intrinsic foot flexors as we look into this achilles tendon? So do not just consider where the pain is, where the actual damaged tissue is, but what might have led to the damage of that tissue in that area. As chiropractors, our basic training helps us a lot with looking into these areas.

I will move through the rest of these fairly quickly. Plantar fasciopathy, we have all seen that athletes, non-athletes, it is that classic pain in the morning, first five steps it is really sore, or getting up from rest. Quite often the pain is on the medial side of the heel, foot strengthening is a really important part of managing that. Don't just look at the painful structure, but what might be offloading or not working to stress that structure out. But also consider that all plantar foot pain is not a fasciopathy. We might have a calcaneal fat pad syndrome. I see plenty of these and people come in talking about their plantar fasciopathy and they actually have got a fat pad syndrome. So consider the pains more likely to be on a heel strike when they are walking rather than mid stance which will be stressing out the plantar fascia. If we squeeze the fat pad, now we have got calcaneus squeeze test which might be looking for fractures within calcaneus. But you all have palpatory skills that well and truly good enough to determine it with squeezing a fat pad over squeezing calcaneus, so squeezing the fat pad and give pain as opposed to stretching the foot into dorsiflexion which will stress the plantar fascia. These people are going to respond more readily to a soft, softer heels in shoes or gel heel cups. Or there is taping techniques which may be covered in your FICS taping course which are actually very effective for a fat pad syndromes. Your taping for plantar fascia is going to be very different to a fat pad. The proper type will get very good results, also when we are looking at plantar foot pain, consider nerve injuries or tarsal tunnel syndrome, the lateral plantar nerve entrapments, medial calcaneal nerve entrapment as

well. As we move through those most of these are soft tissue-based entrapment of the nerves, we are seeing pink here, lateral plantar nerve medial plantar nerve going down here. The previous slide shows your distributions of where you might feel a pain for these. Understand that again, have a poke around, see where the pain is going. Is there any tingling numbness paraesthesia associated with the symptoms that the patients are getting? Consider that the muscles for the foot are very strong when we have that divergence of the tibial nerve into the lateral plantar and the medial plantar nerve, which is between the digitorum brevis and the quadratus plantae muscles. These are strong muscles and any sort of adhesions in through this can certainly create irritation to those nerves. Can be traumatic if someone has landed heavily on that area but certainly be considering these as part of your plantar foot diagnosis. Tarsal tunnel syndrome, is where our posterior tibial nerve passes through what is the flexor retinaculum or tarsal tunnel. This will create a more generalized effect throughout the foot because it will affect both medial and plantar, the medial and lateral plantar nerves. So consider your distribution is a clue to where there might be an issue. Calcaneal nerve you can see it passes posterior the tibial tarsal tunnel, so it is going to be more localised in that medial heel, and you will feel that tenderness medial calcaneus coming around underneath. Rather than passing underneath the foot or starting underneath the foot. Our calcaneal nerve entrapment, one of the common things here can be inappropriate footwear. So where the shoe comes up and presses heavily under that medial malleolus certainly be considering that as one of the things that may be driving some of the heel or, generally heel pain with your calcaneal nerve entrapment. Tinel test, basically just tapping over the tarsal tunnel, we are not going to worry too much for that. Tap over there and you will see they will get the referral down into the foot over various areas.

Compartment syndrome, it is super important to be able to identify an acute compartment syndrome. These are medical emergencies. Generally you are going to have a significant trauma associated with a crush-type injury, broken bones, those sorts of things. The patient will be in a lot of pain and the pain will increase rapidly. We are looking for significant pain, we are looking for a rapid change in temperature of the leg, your pallor, paraesthesia pulselessness and paralysis. This will be a field side diagnosis, this will not walk into your practice. If someone has an acute compartment syndrome, and you are field side, you are there when it happens, you are referring off immediately. The ones that will come into our practice are the exertional chronic compartment syndrome. That is where, again, training load will often be spoken about. and there might have been a recent increase in these but consider again, training load is just one of the features. Particularly if it is happening on one leg, it will often be bilateral but why is it happening there? Why is it happening in a particular compartment? Why is it happening on a particular leg? what has changed or what can you identify within this athlete that might help work out the whys of what you are looking at with these injuries. We are in a great place to be managing these, like generally soft tissue looks important, but that relationship between the tibia and fibula is super important when looking at compartments in regards to which compartment they are occurring in. From this perspective, muscle tests, nerve referrals are going to clue you into which compartment might be related and how you might need to be looking to manage that, and also what other factors might be related.

We are going to muscle strains and tears and we are just going to run a quick video, which is probably one of the more famous hamstring tears that we have seen in recent times.

### **WATCH VIDEO:**

This is the 2017 World Athletic Championships: Usain Bolt's last race. We see him tear his hamstring here, as he is about to come through and win the 4x100 relay. There he goes, and classic hopping as there is no propulsion left. Once that tears there it goes, he is not a happy man. So this was the end of his career. A sad way to go out with that race. A hamstring tear is quite often a high-velocity tear. When we look into sports, and again, the figures that you will see on the left-hand side here are football based. Hamstrings are the most common injury, then we see groin/adductor strains, quads and calves coming in after that. A lot of focus on hamstrings and how we might look after those. A great paper from the Danish came out last year, where they assessed over 10,000 papers. They came down to 44 of them which were largely randomized controlled trials and systematic analysis. The conclusion that they came to was that there are not a lot of high-quality papers out there. When we have a look at reducing groin injuries, the FIFA 11+ Program and also the Copenhagen Adductor Stretching Program can reduce groin injuries. Nordic hamstring exercise, pretty good for reducing hamstring injury rates, and we are looking mostly at fascicle length changes there with the a nordic hamstrings. Which also might be why lengthening exercises appear to be superior for return to play for hamstring injuries and also reducing reinjury rates. One of the things they did make a point of saying is that PRP does not appear to have an impact on return to play or reinjury rates with muscular injuries of the lower limb.

Interesting comments there where they did not make a comment on calf injury diagnostic tests. We are just talking muscle injuries here, diagnostic tests injury prevention or return to play because of the lack of evidence there is in that area. So what is our role? Apply the best available evidence that we have. So the Nordics, the Copenhagen strengthening program, FIFA 11+ then be a sports chiropractor. Ask why. Why did it happen there? Why was it that muscle? Why was it that bone? Why was it that joint? Now outside of our traumatic injuries, with the cumulative injuries in particular, we need to be asking why and then applying our knowledge of sports chiropractic to look at the system and not just look at the injury or pain site and say how can we help this athlete by finding what area might be not taking it is load? That is creating a mal-loading situation in the area where the tissue is broken down. Lastly, before finishing up, just another one to be super aware of in the lower limb, our quadriceps contusion or cork. The big issue there is the development of myositis ossificans. Look for someone who has not got early treatment, they have got knee effusion on the same side, they have got a previous quadriceps injury and their knee flexion less than 180 degrees. Myositis ossificans where we get the bone deposits within the muscle can be a very painful and sometimes career ending injury, which quite often can be avoided by managing these things early.

All, thank you very much for your attention tonight. I know this has been a long one to sit through, but both Thomas and I appreciate your time, your attention and your involvement in FICS. Excited to see

FICS ICSC LE Assessment Dr Peter Garbutt and Dr Thomas Jefferson , June 2021

you all sometime in the coming years at some sporting events, hopefully up in your different regions around the world.

[End]