ICSC051.4VIEWFunctionalAssessHipandKneeDrTimStark 53.30.mp4

ICSC Lower Extremity Module 5
Section 1.4_ICSC05
Instructor Timothy Stark
Video Lesson: 53:30

In this lesson, we are going to look at functional assessment, namely of the hip and knee. There are a whole lot of programs for the foot and ankle foot. Foot and ankle are a little bit different. Hip and knee have a lot of similarities and how we might assess the hip and the knee joint. We thought we would put it in a single program. As we have shared in previous presentations like this, this is a high-level instruction.

We are giving some general concepts and not doing a drill down, and spending hours recording videos for you to basically spoon feed a bunch of information. It is really important that you are able to read and critically evaluate literature that's available to you. In these videos, we are just giving you high-level instruction, and we hope that you truly do find this to be valuable and basically establish a foundation for further knowledge.

As we get into our outline for today's discussion, we are going to talk mostly about assessment. We are not going to get into rehabilitation on this PowerPoint, that will be another upcoming video, and succeed in this functional assessment lecture. What we traditionally do when we teach rehabilitation, we talk about progressions of functional assessment, progressions of rehabilitation. It is very important to understand where you should start and how you should progress. We will be discussing that for the hip and knee in this presentation.

Generally, where do we start? We generally start with touching. That is very non-invasive. The patient has tenderness or dysfunction in the hip joint, maybe the labral tear, for example, taking them right away into Orthopedic and range of motion assessments probably isn't the best place to start.

Before we get into our functional assessment, let us look at our structural assessment needs. Look and identify how they are standing and holding themselves. **In Tier 1**, we are looking and maybe touching to identify tones, there is no movement, and other than gravity, there is really not going to be any load on this page. We are not going to be applying pressure against muscles or putting pressure on the joints.

Some of the things that we might want to look at in regards to hip and knee dysfunction, and particularly with the hip, I have noticed that paradoxical breathing can be an issue with slowing the process of healing and rehabilitating a chronic low back and hip issue. You don't know much about paradoxical breathing, and again as I said, is a high level of discussion. Do a deep dive, do a look up at paradoxical breathing in PubMed and explore for yourself. What that is and how it might affect lumbar spine and hip dysfunction slow rehab.

Faulty mechanics are something that we want to look at? A sports chiropractor is really good at identifying joint play of the hip and joint play of the knee, including the patella and the whole knee complex, and certainly the whole kinetic chain? But this is a hip in the lecture. If there are junk restrictions and capsular restrictions with our skills of mobilization and manipulation where people imagine those faulty mechanics, we certainly want to look for them right away.in our functional assessment.

Then, static posture. Static posture, oftentimes, can give us some pretty good information in regard to what is happening with muscles, out of which might be a little bit hypertonic, hypotonic, or chronic soft tissue contractures, and general posture. If we look at this athlete, in these top two pictures, we can notice that looking at her from the back, she has a slightly increased thick angle on the right-hand side. Well, what is causing that? She could be overchronating, she could have some tibial torsion, she could have some femoral torsion, she could also have retroversion of the hip, coxa retroversion, or just chronic, externally rotated of the hip. Maybe she sprained her ankle quite some time ago and she was used to walking slightly, externally rotated, to take some load off the dorsiflexion movements. A lot of things can be contributed to how one person basically holds and stealth while they are standing and walking.

As I said in our earlier presentation, that is when we are identifying one little problem, it doesn't necessarily mean much after that. It usually means that we have to keep looking and find another piece of the puzzle and see if they could appropriately see what that picture actually is.

Another consideration for this particular athlete is that we can see that there is more space between the right arm and her trunk versus the left arm. That could be an indication of scoliosis or pelvic un-leveling. Maybe the scoliosis is secondary to it in anatomical short leg, but certainly, it could be affecting hip and knee dysfunction. It is just a piece of the puzzle and we need to do some further investigation and identify what the issues are.

Then if we look at her from the side, we can see that she probably has this anterior tilting of her pelvis with a increased lumbar spine doses which is kind of hidden behind her arm little bit but certainly would be affecting general muscle tone and hip position. If we consider the knees, there are a number of things that we can also consider, whether they have Genu valgum or Genu varus presentations, which certainly would be influencing how healthy that need might be or could be down the road if not addressed.

Functional knee posture. As we look at somebody's posture standing but we know that certainly, our athletes are very active when they are lifting weights or maybe even our athletes spend a lot of time in a seated position throughout the day, so we want to observe them while they are functioning and moving around.

As our weightlifter is starting to do deadlifts, clean and jerks, or snatches, we want to certainly assess their biomechanics. We can see that his knee is probably coming pretty far forward of his foot and ankle, and if he's reporting to you with anterior knee pain, it might be because of his mechanic. He probably needs to get his bum a little bit further back, get his knee further back over his ankle a little bit, and there would be less load on that anterior aspect of the knee joint. This is just one example of how somebody in their dynamic environment on a day-to-day basis might have an influence on their new presentation. It's an individual that was probably asked to jump in place or do a squat, and we can clearly see that there are some Genu Valgus presentations here that could be coming from the foot and ankle, could be a knee issue, could be a hip and low back issue, and again, that's just one piece of the puzzle. We need to do some further investigation.

As I mentioned earlier, athletes might be rather stationary. Many of them are students and they have to study for long periods of time, and maybe some of them work in a workplace. We want to assess the ergonomics as well, ask them some simple questions about what type of chair they have, the setup of their desk and whether that's conducive to a healthy environment.

We talked about dynamic movement and as I said, watching your athlete perform various different activities is going to be killing and I can see that my media is not found here but I apologize for that. What we have here should be a video of an athlete that's running and every time she was fully weight bearing on this leg, her opposite pelvis or her opposite hip would drop. What's happening is on the closed chain side, her hip is going into adduction. One person might say that her glute medius is weak and that may be true but we can't conclusively say that based on a video of just watching one person. We would actually need to muscle test that glute medius effectively, preferably using a handheld dynamometer which we'll get to here in a bit but quantify whether that glute medius is truly weak compared to the other side. Maybe it's a neuromotor problem, maybe it's not that the glute medius is weak, maybe it's that the muscle is simply stupid. It might be strong; it just doesn't know what it's supposed to do. It doesn't know that it's supposed to stabilize the pelvis when they are in a closed chain environment.

Presentation 09:16

Continuing into Tier 2 functional assessments, Tier 2 as compared to Tier 1, there is no movement and there is no load. We are just looking at touching as you noted with Tier 2 with that previous video that unfortunately, didn't work. With Tier 2, we are now making the athlete move throughout their environment sometimes and perform simple functional tests and this Lower Extremity Clearance test is super simple to do. If you are in almost any of your treatment rooms, you don't need any extra equipment to do it. It doesn't cost you anything and gives you a set amount of information. So, as we consider the athlete performing a squat, which is the lower extremity clearance test. We are trying to identify is, how low can he bring his bum to his heels.

His hip joint is going through a lot of flexion, but also, if you look at what's happening with the ankle, the ankle's going through a lot of flexion as well. The athlete is unable to lower the bum all the way to the heel, and what commonly happens, in my experiences is that they get to 90 degrees of hip flexion, and they just say, "I can't go any further." and then you asked them, "Why can't you go any further? Are you feeling an issue with your hip? With your knee or with your ankle?" and commonly, the response is, "I just can't go any further. I just feel like I am going to fall over." I think this is a tell-tale sign of a chronic foot and ankle issue, not necessarily a hip and knee issue. When you watch the foot and ankle in the clearance test you need to consider all of that.

The next step in this test, let us say that this athlete was unable to go, and you gave several attempts, then ask the athlete, "Okay, well can you go low enough to create more knee flexion. " Also note that you should try to see if the athlete can go a little lower than they are used to with their knee. The next step is to now, go ahead. Raise the heels. As you can see in this picture the athlete is able to lower their bum all the way to the heel, with their heel elevated. What it tells us is it that it was probably not a knee problem that stopped them at 90 degrees. It probably was not a hip problem that stopped them at 90 degrees. What's stopping them at 90 degrees is an issue with the foot and/or ankle. Hence, the lower extremity clearance test looks at and rules in or out hip, knee, ankle and foot issues when performing this simple test.

We have to certainly appreciate that when we are performing this test, we want to perform it not just by looking from the side, but also at that place in the front. We can see as this athlete is going into the same squat, that went pretty normal from the side, it doesn't look all that normal looking at him from the front. We can see that he might be overpronating a little bit on his right side, maybe the knees are going into a little bit of Genu valgus. He is shifting his weight a little bit to his right, what does that tell us?

Well, it doesn't tell us a lot other than that. There is something not symmetric in regard to how his lower extremities are working through the lower extremity clearance test. We need to do further investigation in regard to this, being a hip and knee program. We certainly would want to perform a further range of motion assessments of the knee and hip, some neuromotor control assessments, maybe some handheld dynamometer, and other types of muscle testing for the knee and hip joint. So we are getting them to that right now.

Another functional assessment that we can do for the hip joint is part of Janda's assessments. Now, Janda's assessments, I think had a lot of merits back in the day and there have been some studies that have come out to basically add some further challenges on how we think about Janda's assessments. The way I have addressed Janda's is that when I perform a particular Janda movement, I don't think it means one particular time. I'm walking out movement, generally.

In the next slide, you are going to see one of the things that we look for in a video. Let us start off with what Janda's Hip Abduction Test. In there, we have a patient lying on her side, the bottom leg is flexed at the hip and knee so that the patient has good balance. We want the patient to abduct their hip and ideally, we want their toe and knee to point forward, keeping their toe and knee pointing forward. While they are abducting, if they can externally rotate that, it might be their neural pattern. They might have a neural pattern of where they naturally want to externally rotate. That might explain why when they stand, they have a cone of posture. That might explain why when they walk, they also walk with a total posture because that is their normal neural motor pattern.

Another thing that I look at, however, and that is why I have a mirror behind my athlete here because when they are starting to go into hip abduction, I want to watch their PSIS and I want to watch how early that pelvis starts to hip hike. If it starts to hip hike really early, it tells me that they tend to be really dependent on their lumbar spine paraspinal muscles for hip movement and that might be why they have chronic low back pain, and that might be why they have some atrophy within the hip muscle structures.

Again, a couple of things with this Janda's Hip Abduction Test, we are looking for external rotation of the hip joint. We are also looking for the deep-sea labral PSIS to hip hike a bit early.

Let us look at an example of when we see some early motor controller contraction of the hip. This is an athlete we had, lying on his side, and we had him starting to abduct his hip. If you watched the video, you will see that the muscle tone fire's really early when his hip had abducted. There is a lot of early hip hiking occurring before the hip

actually goes into abduction. Even when we were queuing him to just abdominal brace a little bit and try to control his pelvis, there was still a lot of early hip hiking occurring. What would cause this whole again? We can't say that this means x equals y, we have to do some further investigation.

When we talked about hip rehabilitation, we are going to show you how we addressed this and try to make some corrections to this aberrant neuromotor pattern of him hiking his hip.

Another Janda's assessment and neuromotor retraining assessment actually is Janda's Hip Extension Test. There was probably even more controversy about this particular assessment and some of this other stuff. Again, we are still in Tier 2. We are looking at movement and neuromotor control, no loads other than gravity. In Janda's Hip Extension Test, what we are looking for is, Janda's first initial claim was that muscles should fire in a particular order. And Janda's hip said that as we are palpating the hamstring, the glute, and the lumbar spine, Janda's said that we should have the hamstring fire first, then the glute, then the opposite low back, and then ipsilateral low back. Subsequent research got me independently found that that's probably not the case, especially in healthy individuals.

What is a concern for us, for patients with chronic lower extremity symptoms and chronic low back pain is that their glutes are firing or elevating in tone really light as we ask the patient to actively hip extend. The motion here is asking the patient to actively hip extend and I just tell the patient, "Keep your legs straight and elevate your knee just an inch off of the table or the floor. Lift your knee an inch off the floor, couple centimeters off the floor." As soon as they start to do that, you can start feeling muscle tone in crazy and various different areas. If they have a significant amount of lumbar spine muscle tone increase long before the glutes increase in tone, they might be really dependent again on the lumbar spine paraspinal for neuromotor control of that hips and that lumbo-pelvic relationship. If the glutes fire pretty early, maybe about the same time or maybe even a little bit before the lumbar spine paraspinal muscle, that might be a little bit more ideal. Clearly, there is strong research for that, the research does show that if there is a significant delay, including motor firing, that can be a contributor or at least an outcome of chronic low back pain, possibly that could be retrained.

When we talk about rehabilitation of the hip and knee in another video, we'll discuss how we can potentially work with retraining this.

Continuing on where we are still addressing the movement of the hip and knee, but we are not applying alone, we want to measure proprioception. Yes, I said measure proprioception. If some of you may not be aware that this can be quantified, they are very low-tech and very easy to do.

For the hip, what we are going to do is we are going to have the patient lie, we are going to have the patient assume a position, so we are going to stop it right there. I backed it up just a tad. What we did is we have the provider, you as inclinometer, in this case, it is a digital inclinometer. We position the patient's leg somewhere in between full flexion and their neutral position where they started lying on supine. We brought their leg up, halfway into that position, it doesn't have to be exact, just somewhere. Then, with the digital inclinometer or your analog inclinometer, you want zero it up. This will be the zero position. Then we have them go into full flexion, we have to lower their heel all the way to the floor, and then they try to recreate that starting position. His eyes are closed, he can't see what his foot is doing, and then while he is trying to recreate that position, the provider comes in here, again, to measure how many degrees off he was compared to that first position. If he is more than 10 degrees off consistently, that might be clinically relevant.

What is more important is to measure the hip and knee and we will show you a new one here, a little bit, to compare it to the good side. If you have an older athlete who had a hip replacement, that would quantify proprioception. Compared to the other side, let us get the good side and see how many degrees off is consistent for that good side. If he is consistently 6 degrees off, that might be his normal for his good side. If you are 16 degrees off on the painful side, that's clinically relevant and we might want to rehab this patient to reflect back on these proprioception assessments. Again, a really easy quantifiable measurement for measuring proprioception in a kinesthetic sense.

Going back and watching that video one more time, I just want to make sure that you have it. We can have the athlete position or you can position them in a mid-range of motion position, be of 0 of the inclinometer. We have them going a full flexion back down to the floor, then trying to recreate that starting position, and then re-measure to measure how many degrees off he was.

Continuing in our Tier 2 discussion, we can assess the stability and neuromotor control of the lumbopelvic and other areas. Here we have got a supine bridge exercise, a supine bridge assessment actually. When we have the patient lying in a supine bridge and the left leg in the mirror here, the left leg is the closed chain side. When we raise the right leg that we see in the video here, we are really placing a lot of load on that closed chain hip.

Now, there are textbooks and I have read some articles that says that when they raise the right leg, if the right hip drops, this is referred to as the supine Trendelenburg, it is a glute medius weakness, and that's not accurate.

This is not a glute medius weakness. If they dropped the open chain side, if they dropped this hip, in other words, the closed chain hip is unable to maintain the pelvis being level. It is not a glute medius weakness. It is most likely, a no motor control and or a weakness of the internal, rotators of the hip, the internal rotators of the hip. Let me explain this. When this hip drops on the closed chain side, that hip joint is going into external rotation. It's unable to hold a neutral position. The internal rotators cannot withstand the load, or aren't smart enough to withstand the load, and they cannot hold back a neutral position, then the hip starts going into extra rotation. Think about that, if you have any questions I am happy to take any questions offline. This is a really simple test, again, commonly done and it actually ends up being a rehabilitation exercise for us as we discussed rehabilitation.

Another Tier 2 exercise, in other words, it was not much movement with the hip or basically having them assume a lunge position and I'm more concerned about it, there is a little bit of movement, but right there, I'm more concerned about what's happening with this hip joint in this position. Can they hold this position? In other words, no movement. Can they hold this position as stable as the other side? The other side was pretty spot-on, it was in the sagittal plane and didn't really have much for difficulty. As he goes into his right hip, he is unable to hold his position. It either is muscularly stupid or it is muscularly weak to be able to sustain this leg in a sagittal plane.

Similar to the lower extremity clearance test that we discussed earlier, we saw that he went into Genu valgus in this another lunge test. It goes a bit basically what we have already discussed so I am going to cross past that and discuss a little bit further about another Tier 2 test that I like.

I like this Star Excursion Test, gave me a lot of information of quantifiable, it does include a little bit of movement, but the closed chain side of the movement is not excessive by any means. It's not going through their full range of motion and the load is just crappy again. The Star Excursion test is basically real simple, take some tape, put it on your carpeted floor or your tile floor, and use a marker or a piece of chalk, and mark where he's going to be touching his toes. Let's start the video here. We are assessing several things, we are assessing your ability for lumbo-pelvic control, so let me just stop right there. One for pelvic control, so we are looking for hip hiking and dropping as well, where there is going to be a little bit of movement of that closed chain side, but not too much. We are looking at stability, we are looking for Jean Nouvel's presentations and overpronation, and we are looking to see how much control he has of that movement at the closed chain side, and how far he can reach. We know that our athletes are out on pitches and courts all the time and they are extending their legs way beyond their normal walking and maybe even in a normal healthy running state. They are reaching out at times to slow themselves down or to re-accelerate so we want to certainly measure how much control they have on that closed chain side. As you can see the provider, he is placing a mark or a strip of paper here. What we are going to do when we are all done is measure from the starting point out to here, before his right leg.

When we marked it in our notes, we mark that the left leg is closed, and what I have in my notes is I have a star in my notes and I will say, left leg closed, then I'll write down 23 inches or 53 centimeters, and I will write down the measurement on all these lines. You will see that we go through a lot of different motions. Here, he is crossing over, which is a typical athletic sport, there is extending back backward, where we see our athletes doing this all the time, reaching as if he is crossing over with his closed chain side.

These Star Excursion maneuvers are maneuvers that are rather consistent of movements, we see our athletes perform on a regular basis, all we are asking for and what makes it different than being out on the pitch because we are asking for him to control it, barely touches toe down, we don't want to put in any way on his toe. We barely want him to touch his toe and we are identifying how much control he has of that lower extremity side.

Another proprioception test for the knee, we showed you earlier proprioception test for the hip, it is the proprioception test for the knee. We are going to ask the patient to be laying prone, we are going to be in position, her leg in a mid-range position, somewhere between full flexion and full extension, it can be anywhere. somewhere around 45 degrees seems to be about a good position to start. It doesn't have to be exactly 45 because what we are going to do with this inclinometer, is zero out our inclinometer where their starting point is. Then, we asked the athlete to fully flex and fully extend and return their knee joint to that same starting position. So, he is going in full flexion, full extension, and he is going to try to recreate that starting position so that if you've noticed, he did not come up nearly as much into full flexion or the starting point. He was probably good, 15 to 20 degrees off with this particular test so we would do that a number of times so that we can get an average and then certainly compare it to the healthier side.

This is a non-weight-bearing proprioception test, if published in peer-reviewed journals and has at least fair validity this is a weight-bearing test. This is the weight-bearing test and I have not seen any weight-bearing proprioception measurements using low tech technology such as an inclinometer. A big individual actually is testing here, he was working on a paper on trying to identify a closed chain proprioception weight-bearing assessment.

Again, we are going to have the patient assume a natural posture, a natural position and then come down into a squat, eyes closed, somewhere between full extension and full flexion, and then we are going to place the inclinometer and I'm just going to back up a little bit. We are going to place the inclinometer on a spot of the thigh that can be repeated. We might want to put a mark on the thigh if you want, a little piece of paper or whatever, so that we can put that inclinometer right back in that mid-thigh, then we are going to ask the patient to go into a full squat, all the way up to standing, and then replicate that starting position. A lot of proprioception is happening here between the ankle, the knee, the foot, and the low back for this patient to be able to quantify and replicate the same angle that he started off with.

It is an interesting study. His outcomes were pretty interesting. What he further evaluated in his study was, does fatigue affect proprioception? You will have to wait for the outcomes of the research, not even sure at this point in time, what the outcome of that study is yet but we have the athletes walking and fatiguing themselves, jogging on a treadmill, and then retested them again after they were fatigued.

Tier 3. This is now the applying a load. We are going to apply a fair load to the athlete. In this case, the athlete is sitting on the wall. You can see the diagram at the back here, she is sitting in a 90-90 position or a wall sit. She has no chair beneath her, her angles are 90, her knees are at 90, her hip going through at 90, and we want the knees, foot, and ankle to be pretty close. So, I think this is too far apart. I would suggest that you bring the foot and ankle a little bit close to each other because of the next step that we are going to be doing. We have the patient make sure that they can assume this 90-90 wall sit position and when they are comfortable, we start the timer soon as they lift one of their feet, that's why we want their feet together. When they lift one of their feet, they just have to look it up to the other ankle a bit of an inch off the floor, a couple of centimeters off the floor, it doesn't have to be very high at all. We want their hands more so on their hips, not necessarily on their thighs. We don't want them using their hands when performing this test. When they lift their foot off the floor, you can start the timer, and you stop the timer if their thumbs lie down on a wall, they are unable to maintain that seated position any further, or they lower their foot back down to the floor, and you can see that the standardized test that both legs combined, they should be able to withstand a male versus female in this amount of time or an average type of athlete.

I would certainly compare one leg to the other as well and identify whether there is a motor endurance issue. Wow! Left leg versus the right leg. Another test, this requires a little bit of material, kettlebells or dumbbells in your office. This is a published study as well and I have a fair validity, this is a 10-point assessment, and it's a single

leg lunge assessment. We started off with the athlete performing a double of a squat test. Lowering their boundary heel and coming back up, they should be able to go beyond 90 degrees in this test and then stand back up. If they are able to go below 90 and come, and stand back up, that's 1 point for each leg. Like I said, this is a 10-point test and it is 5 points for each leg. That is the best that you can score, 5 points for each leg.

We go back to this first step, they are able to do a squat, did stand back up, that's 1 point for each leg. Then we have them perform a single leg lunge, so I just position then. In this lunge position, I haven't hold it. Then I want her to lower her back knee, all the way to the floor, bending this knee to about 90 degrees, the front knee to 90 degrees, and then extend back up, lifting this knee out of the floor of the back knee, and bringing it, that's finally, almost in full extension. If she is able to do that, then that knee now has another point so it is 2 points for that leg and 1 point for the other.

Now, her left leg, in this case, has now got 2 points, if she's able to do that, then we add 10% of her body weight, that's what the dumbbells here are for. We add 10% of her body weight total. 5% in each hand. So, 10% total. And again, we have her perform a single leg lunge. Lowering her front leg to 90 degrees and then extending back up, if she's able to do that, this left leg now scores another point, so now it's 3 points to 1 point on her left leg. If she's able to do that effectively, we put those dumbbells down, and we grab another 10% of her body weight. Now, she's holding a total of 20%. She's holding a total of 20% of her body weight, 10% in each hand and we have her perform a single leg lunge, lowering her back knee, and flexing her front knee to 90 degrees, If she's able to do that, she puts these dumbbells down, she grabs another 10% of her body weight. So now, she has 30% of her body weight and both of her hands total. 15% roughly in each hand and we have her perform this single leg lunge again. If she is able to progress all the way through these, without hesitation and without pain, she has scored 5 points on her left leg, and then you repeat it with the other leg so that maximum score would be 10 points, 5 points with each leg.

There was an interesting study, the outcome of the study was that they took many athletes, individuals that have no knee pain, no hip pain, and they found that the average score was around 9. You think this would be kind of easy, but in a healthy group, they found that the average was about 9. An interesting study, very low-tech, you just have to have some dumbbells or kettlebells or some sort of other weights and can effectively be done in your office.

Let us talk about muscle testing a little bit. We are still in Tier 3 and what we are going to be doing is applying a load to muscles. So earlier, when your athlete in a previous video and the video that didn't work again, we were suspicious on maybe a glute medius weakness. Because it is based upon how they function, but there was a prediction and not a confirmation. This is where we confirm it. If you are concerned about a strength or weakness, you need to muscle test, you need to use a muscle test. Ideally, you can use a handheld dynamometer and actually quantify how much force output that muscle or that motion, in this case, hip abduction and hip adduction, how much force that those motions can produce? Then you are actually quantifying muscular and qualifying whether there is a weakness there or not.

In 2017, there is a systematic review that demonstrated a very high correlation with handheld dynamometry testing of the hip was completed and there was moderate correlation when testing the knee and ankle when compared to the case of kinetic testing. I published a paper back in 2011, handheld dynamometry as well. You can look up start and you can read my paper on handheld dynamometry. That was just another systematic review, mine was a systematic review as well. This is a new systematic review, I mostly looked at knee and hip, and so certainly, an appropriate part of this discussion.

Isokinetic testing is the gold standard for measuring muscle force output. There is that gold standard and like my systematic review, and in 2017, when they compared the handheld dynamometer, a small little device that costs you probably less than $1000, roughly around $1000 USD American, it lines up well with the findings of isokinetic testing that might cost you $200,000 for an isokinetic testing device. It's a worthy investment. A thousand dollars is not asking a lot to be able to quantify force output. If we can take this offline as well, you can email me if you want any recommendations of handheld dynamometers out there.

Here on the picture, on the left-hand side, we have a picture of this provider, assessing a patient for their abductors, so she's lying on her side, the top leg, as you can see in the mirror, she's basically using that for support and stability. The bottom leg, in the mirror, in the bottom leg here, she is going to be asked to elevate her knee, the side of her knee, off the table just a little bit. In other words, contracting her abductors, then the provider flies into a consistent spot down by the medial malleolus with the dynamometer and applies pressure, instructing the patient to push up into the device. It's really important and I think I have commented on this in my paper from 2011, that patient initiation is really important and that's all based upon how you phrase it to your athlete. We want the athlete to initiate the contraction. There is the right way, we tell the patient to push up into the device. Push, then you are resisting, and then you are going to overcome this thing. That is going to measure their maximum force output into abduction. The wrong way to do it is to tell them to resist you. If you tell the athlete, "Resist me." They are not really sure how much force you are going to be putting into them and the research shows that the consistent output of the athlete is less consistent. The output is less consistent. So again, the correct wording is to have the athlete push or pull, depending on what muscle you are testing to initiate the contraction first, so that was abduction.

The abductors, you notice that the patient's still lying on her side, the bottom leg is now flexed, like we had in the Janda's position, Janda's abduction position of hips, flexed knees, flexed or balanced. The top leg is straight, and the ankle, knee, hip, and shoulder are all in a straight line. We are going to ask the patient to abduct just a little bit. You notice that she's pretty much in her anatomic position. You can take her out into abduction, just a little bit, but we don't want to muscle test away. I want a 45° abduction. Because our athletes, do spend some time there. In that position, they spend probably most of their time with their feet about shoulder width or slightly wider so we want to muscle test them in that position.

You can see in the mirror, you can also see in this closer shot of a video of the picture that the Dinah loggers is in between the patient's hand, and again, a consistent spot just above the lateral malleolus. Importantly, in both pictures, you'll notice the provider is stabilizing the pelvis. This other hand has to do something, it has to stabilize a patient. If this provider did not stabilize the pelvis, the ghastly is going to use a lot of low back muscles, it could try to fire the abduction, or fire into adduction on this picture and we are not going to be effectively measuring in motion and force output. So make sure that you stabilize, it's very important to get accurate testings.

Some other muscle testing and handheld dynamometry positions for the hip joint for the hip flexors, we can have a patient lie supine, bring that hip just into a little bit of flexion. If you are strong enough, you can probably put the dynamometer just above the knee. But using a longer lever, you are going to be able to overcome that patient's hip flexor mechanism, which does include the rectus femoris, the rectus femoris is certainly firing it. If we use a longer lever and place a dynamometer lower in the leg, you can see that the output provider is stabilizing the opposite pelvis.

I am going to state here on the hip extensors, the provider is stabilizing the pelvis, the knee is extended, the hip is extended, and the knee is a little bit off the floor. Again, we are using a long lever. Some of the muscle testing textbooks, tell you to place a dynamometer, your hand here. When you use short levers, the provider has to use more output. The validity and consistency is less. If a provider can easily resist the muscle output and overcome their strength, which is called a brake test, the consistency and validity of the test increases.

Lastly, for the knee flexors. You can see that the provider is stabilizing that issue of tuberosity, and the knee is flexed, the knee is on the floor or on the table and the dynamometer is on the distal end of the leg once again, and again, most of the textbooks, tell you to position only at 45 degrees. In my experience, even average strength athlete or really strong at 45 degrees, it's really hard to overcome them at 45 degrees. Research also shows that hamstrings will tear, oftentimes, at about 20 degrees of knee flexion when firing eccentrically. You can see that we have this athlete roughly at about 20 degrees because of that reason, that's probably where the hamstring is probably out of one of its weakest points. So, why not test it there?

You know, holding test. For those of you about a little bit savvier with lumbar spine. Lumbar spine rehabilitation of functional assessment, you might be familiar with Sorensen's Holding Test or Lumbar Spine Extension Test, and that's referred to as holding test, is basically asking the region to fire against a resistance for a longer time. When

we are muscle testing on the earlier slide, we just have them do a maximum output for about 2 seconds and that's it.

For inner holding, for asking for a submaximal muscle contraction submaximal for as long as they can hold. Let me explain how we might do this or a hip muscle, and this is just one example. Here, we have already performed a maximum output for hip abduction. We already know what her maximum output is. Let's say, it's 38 kg, she's able to abduct against this handheld dynamometer or the maximum output of 38 kg. What we do is we take about 70% of that. Let's say it's about 28 kg, we have her push into the device, the device is telling us how many powers she's pushing until it gets up to 28 kg and then we start the timer, and we have a whole of about 28 kg of force for as long as she can. And then when she fatigues, can we stop the timer? We are able then to quantify how long she can withstand a submaximal load and prepared to be non-injured side. So, that is an example of an inner holding test.

Another published test is this test for assessing level pelvic stability, which would include the lumbar spine, the hip joint and some of the extensor mechanisms of beneath, and we go help the athlete extends back to about 70 degrees - so let us see if we can stop that much of why it dances.

So we have asked the athlete to extend that to about 70 degrees. How do we know that? The provider is using an inclinometer right here, we are measuring, or they started at 90 degrees and they extended back to about 70 degrees, and then the providers are going to keep their hand in the back right at 70 degree mark. We are going to ask the athlete to come back up to that starting position and he is going to go back and forth as frequently as he can in 60 seconds and what we are looking for, is fatigue on his lumbo-pelvic stability. If he starts to flex his hip right here, we want him to be a straight line from the shoulders to the hip, down to the knee. He should be able to maintain a straight line. If he starts flexing as tip, we know that he's lost a lumbo-pelvic control. Or maybe his lumbo-pelvic control is very good but it just doesn't have the endurance of the knee extensors to be able to eccentrically recline him back.

As far as I could tell in this study, there was not any standardized data. It's a starting point so we can count how many times he was able to do this in 60 seconds before he broke his form, and then as we are rehabbing the patient, we can determine whether he is improving them in his outcome.

Box drops are really easy to perform if you have a couple of steps. Even when you are out, you can certainly perform on there or just build a box, or just stand from a chair. You can see the height of this box is roughly the height of maybe a small chair. Again, there is some potential risk of an athlete of hurting themselves. We want to make sure that it's done in a safe environment, and this is only done if we think of patients able to effectively do it. If the patients recovering from hip replacement or labral surgery, we are probably not going to be progressing into a Tier 4 exercise. Tier 4 is beyond adding just lower, it becomes more of a ballistic, more sport-like activity and making it a higher-tiered functional assessment. These box drops, there is evidence to show, and support box drops have given us some really good information.

You can see that as he drops, he comes overpronated, he goes on the genu valgus just a little bit and it could be that he's enjoying rotating his hip joint as well. Maybe, there are no neuromotor controllers and weakness there. So that leads us going back to our handheld dynamometry to determine if there was a weakness. There really isn't weakness there, maybe it's a neuromotor control issue. Totally, box drop's really easy to do because it's a fair amount of information. And then last week with functional testing again, this is much a higher load testing, we are into Tier 4, this isn't ballistic, but it does go. We do take the athlete to what is called mobilizer fatigue. In other words, she's going to be performing a living press. There are various different tests available out there that are standardized. Some of them have 100% of their body weight on the leg press, some of them is 1.5% or even two times their body weight and we are looking for certain number of repetitions. So, again, you can do a quick little search for standardized tests for leg press if you happen to have this device, but we have a leg press available to you.

Another simple way of measuring mobilizer fatigue and maybe even maximum mobilizer endurance output is we are going to bring close to this discussion. This was, again, a high level of discussion to help you understand how we can functionally assess the hip and knee. I think some of the things that are really helpful for me, in helping my

athletes over the last many years are measuring proprioception and also some things that aren't necessarily discussed much in your undergraduate, Chiropractic program. In this certainly, postgraduate program, measuring proprioception, I think, is really easy to do as low-tech, it can be done weight bearing, it can be done non-weight bearing, and pretty easy to measure. In a Star Excursion, I use that a lot as well. Again, it's low-tech, it doesn't require much of anything more in regard to materials and financial involvement, but yet, gives me a lot of information and handheld dynamometry.

Handheld dynamometry, I have kind of fallen in love with it over the last twenty-some years. I think it really gives me some really good information on whether a muscle truly has a motor weakness or not. What's interesting as a sports chiropractor is if you are assessing your athletes before you treat them, then perform a treatment, adjust them, then do that handheld dynamometer test again, and see if there is an immediate change.

Let me give you a quick little case study before we bring closed. We are working with an Olympic athlete, this was right before the 2016 Rio games and she had already qualified for the 100 meters, and she had flowing in to work with us because she was a little on the small side. She was 5'3" compared to the 5'9", 5'10" sprinters that she was going to be running again. She was looking for some thoughts and ideas on how she could be a little bit faster so when we are evaluating her, we did the Star Excursion, we get all these tests that you saw in the videos including handheld dynamometry.

We found that her right hamstring was 28% bigger. Her hamstring was 28% weaker compared to her left side. Well, that's quite substantial, she didn't have any pain, she didn't have any complaints, but that was quite substantial. I told her, "We have a finding here, we are going to explore to see what the potential cause is." I started looking at the foot and ankle and found a restriction and adjusted it and remeasure the hamstring, and there was no change. That worked my way up the leg and the fibular head was stuck. It's over-restricted as compared to the other side. I thought hamstring attachment should be credible and get that moving.

I adjusted that, rechecked her hamstring, and still went 27, 28% weaker, it didn't really help out at all. We worked our way to the soft tissues of the quad and hammy, up to the hip joint, found that the hip joint was restricted and [inaudible] while inflection and it internally rotated so we adjusted that, really influenced that posterior capsule big of joint, reassessed the hamstring. Right hamstring ended up being now 7% stronger. It was like 35% swing and strength.

As I said these handheld dynamometers, they can be very valid if used appropriately. I have been using it for a long time, I had my fellows in the office as well and we couldn't believe the outcome that was supposed really impressive. This whole sports chiropractor thing can be really impressive, use some of these tools if you want to spend a little bit of money, handheld dynamometers are great little investment to help you identify and dial in your athlete. Make sure you are working well.

It has been my pleasure to guide you along a functional assessment discussion for hip and knee, and I wish you continued success as you move through the rest of your sports chiropractic training. Thank you.

[END]