ICSC Culture Diversity Module 09
ICSC09 _Section 3_Pediatric Athlete
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Video Lesson: 1:29:39

Welcome to The Pediatric Athlete. I would like to first go over how we consider the pediatric athlete a little bit differently than what we would what we would call “normal-age” athlete, which will be from late teens and through their 30s and 40s, and then our masters athlete, which we will also look at in another subsequent module. We need to think about how might we assess the pediatric athlete differently, what injuries are they more predisposed to or less predisposed to, and what do we need to be on the lookout for as sports chiropractors.

Our objectives for this lesson is to dive into the specific pediatric athlete and look a little bit deeper into how you might assess the different injury predispositions.

The first thing we think about is, age is a factor. It is a huge factor when we are considering injury, injury predisposition, and injury assessment. We think about some of the injuries that are only seen in certain age groups. That would be not unlike the masters athlete as well, but we will going to see a lot more of apophyseal injuries or growth plate injuries. We need to be familiar with those and be familiar with how to assess them and when to be suspicious that there is one present.

We also notice that some diseases are not sports injuries, although they may be present as such. For the youth athlete, sometimes they come with a health history and sometimes they do not come with a complete health history. Sometimes it is us that uncovers that health history. This is something that we need to keep our scope broad sometimes when we are evaluating the pediatric athlete, so we do not miss anything.

Age is a determining factor in overall prognosis. That is significant. When we think about the younger athlete, they tend to have a higher metabolic turnover. We tend to see healing happen at a more rapid rate than, the masters athlete, which is pretty interesting. Sometimes our medical math timeline on tissue healing is going to be a little bit different as far as return to sport considerations.

Think of the interesting statistic, the age of athletes and injury predisposition is your athlete's performance, it is inversely proportional to age. The older the athlete, the lower the performance, typically. Then the younger the athlete, the higher level of performance. The athletic intensity and duration of activity will decrease with age. Their workout should look a little different. The load should look a little different. Their training should look a little different. Different injuries with different age groups are a huge consideration as we have already mentioned. We need to think about apophyseal injuries or Salter-Harris type fractures and all the Salter-Harris classifications.

You might have seen this graphic before in earlier modules. Youth sports is a huge culture in society today and thinking about where most of our injuries occur. Some parents are a little savvier and guide their children away from more of the higher impact sports in lieu of a less impact or less injury-prone sport, which is pretty smart for them to premeditate that. However, we need to consider which sports have the highest injury predisposition and then what injuries we see particularly with each sport. If we look at men's football, this is American football here, it has an extremely high injury rate compared to women's indoor track. Understanding where I might see most of my tendinopathies, it might be a lower limb tendinopathy in an indoor track. The higher predisposition for injury would be concussion in a football player like this. Very high predisposition there.

As we look at sport teams in these youth athletes, we know that a large number of injuries in athletes occur are more musculoskeletal origin. Therefore, we need to own our soft tissue evaluation and our soft tissue skills, particularly for the youth athlete. We have both intrinsic and extrinsic factors as relating to sports injuries. Let us investigate a little bit more about what that means.

When we talk about extrinsic factor in injury predisposition, we think about the things like the level of competition, the skill level, the duration and intensity of the competition, the length of time that person's been in sport, the weather. Things that that athlete cannot necessarily control, or they are controlled by outside sources — extraneous factors.

Intrinsic factors are things that are more inherently affect the youth athlete. It would be age, gender, and hormonal changes. Huge things with menstrual disturbances now and as the female athlete goes through her menstrual cycle, different changes in collagen formation, stability, injury predisposition. Super interesting stuff on the forefront of research today. Do they have a history of previous injury? The greatest predictor of injury is a history of previous injury. Therefore, these are intrinsic factors that are going to predispose a youth athlete for another injury.

Their levels of fitness. How are they coming into the sport? Are they physically able? Physically fit to do the sport, or is their fitness level low? Some children are born with hypotonia. With those low tone levels of muscle, their body has a different expectation of activity. We want to think about upper versus lower limb dominance.

As we have these youth athletes, think about how am I going to take a youth athlete and train their body well, so that we have a functioning quasi symmetrical healthy body as a young adult. That is a huge consideration as we are encouraging these youth athletes to participate in sports and physical activity. Posture and intrinsic factors such as poor technique, inadequate concentration, or metabolic things like not eating enough, not enough caloric intake for the activity you are doing — these intrinsic factors we tend to have a little bit more control over that we can manipulate and help our youth athletes perform at a higher level.

We need to understand that these youth athletes do not have a lot of professional guidance sometimes. In many settings, they are just a parent that is coaching and then a parent that is caring for the athlete. When we see asymmetries or pain crop up, who is there to help these young athletes? That is where we come into play. I feel very strongly that us, as sports practitioners, need to be able to recognize when somebody needs a little assistance and be able to do really good quality musculoskeletal assessments in these youth athletes.

If we were to look at this young softball player, obviously, this young girl here, you can see the difference in her dominant. She is a pitcher. Right arm here versus left. That is something that is earned from lots of practice and lots of hard work — that muscular difference. However, how can I unwind that? What exercises can I teach this young athlete, so that she is not so dominant for the rest of her life. We need to have some of what I call unpeeling exercises or exercises that help us even them out from the repetitive motion stuff that they are doing. We are not going to change that, but I can give her exercise on the left side to balance her body out a little bit and help improve the overall performance of her kinetic chain, which is super important for trying to gain power out of the upper extremity.

For just thinking about the shoulder in and of itself, we always hear the term bursitis mentioned. However, if we think of the glenohumeral joint in the youth athlete with girls, the centers open. Not unlike any age athlete, or person that we are treating a shoulder, we need to think of it as a golf ball bouncing on a tee. We need to have the anterior structures and the posterior structures balancing that golf ball on the tee, as well as the superior and inferior structures.

If we have somebody like the youth athlete that we just saw, that is really protracted in the end in the shoulder region so she is rolled forward quite a bit. We have a dominance of her anterior shoulder. Therefore, we have a weakness of posterior shoulder. If we have a weakness in our posterior shoulder, our eccentric contraction is poor for our external rotators. That means inefficiency in slowing down the arm as we throw. Then we are going to be prone to rotator cuff injury. We need to understand how the youth athlete, and at a very young age, try to balance their bodies a little bit more and make sure that that balance is lending itself to a healthy productive athletic life and a healthy productive adult life as well.

Common sports injuries of the elbow. We see a ton of lateral epicondylitis and tendinopathies, medial, what we call little leaguer's elbow or medial epicondylitis in athletes. How is the youth athlete different? How does the structure of the elbow consider just a little bit different in the youth athlete than in somebody that is post-growth plate closure? When we think about elbow injuries here, we need to look at it in layers. I always usually like to start intraarticularly when I look at a joint and work extra-articularly. However, in this instance, this example lends itself to looking at the muscles first. If we think of just looking at a typical elbow regardless of age, we look at the lateral complex here, and we understand the difference between the extensors — the extensor carpi ulnaris, extensor digitorum, longus, extensor digitorum brevis.

We think about anconeus which you cannot see under here, but we think about this massive expanse of muscle that is trying its best to function with throwing or catching, or whether we are doing lacrosse or gymnastics landing and pushing off of the arms. If we understand a youth athlete, we need to understand that there is a growth plate issue. On top of these layers of muscle, we have six growth centers around the elbow. Some of them do not have solid points of origin or insertion because they are originating or inserting on a growth center and apophysis.

We have to understand the maturation of the athlete and this helps facilitate our accuracy of diagnosis because, really, that diagnosis is how we should be laser-focused. Getting a good diagnosis first before we decide what our treatment care plan should be. Reacquaint yourself with the elbow and the tri-joint complex, three joints here. That is the radial ulnar joint, the radial humeral joint, and of course, the ulnar humeral joint. All of those need to function in close proximity with a lot of muscles contracting and eccentrically and concentrically contracting in a small area. Once we increase the load too rapidly of a tendon that is when we start to see our tendinopathy injuries occur.

Let us just take a minute and look at the growth centers at the ages they appear. This is when they first appear. It appears in this order here. We use this order, CRITOE, and that is our mnemonic. C would be your capitulum and that would be here. This would be at age one. R is your radius. Here is your radial head. The interesting thing about this area is we are going to look at a couple different injuries of this area here from these two growth centers hitting up against each other. Two growth plates approximating each other — not optimal for injury prevention that is for sure. That is at age one and then age five to six. Also, at age five to six, we tend to see the medial epicondyle start forming there.

Remember there is a little bit of latitude with this, depending on the tender stage, the age of maturation of your athlete. Some high-level athletes, some elite athletes such as gymnasts tend to mature two years late. If we are talking about a five to six-year-old gymnast, we might be talking about a four-year-old gymnast, skeletal maturation-wise. Just keep that in mind.

Then we go ahead into our trochlea, which is at our six to nine-year-old age here. Then, we are going to go into your olecranon, really interesting insertion of our triceps there, so lots of triceps contraction around that eight to nine-year-olds. Then, our external or lateral epicondyle, 10 to 12 years old. This is

really significant if we think about our little league pitchers or youth baseball players that are using that lateral epicondyle quite a bit to throw a baseball or softball. That is just forming at age 10 to 12. At that age, they are already quite active in sport. That means that that common extensor tendon is really floating in space and really pulling quite hard on this growth plate. Understanding these six growth centers for youth athletes are very important when we consider evaluating the elbow in an instance of elbow pain for the youth athlete.

Here is our CRITOE. Here is our age of origin. What we need to do is we need to use these ossification centers to assess skeletal age and injury predisposition. As we have somebody with elbow pain, we are going to evaluate their skeletal maturation age as we are doing our evaluation. That is important to consider and let us not neglect these growth centers. I bring the elbow up because it is a little more complex than most of the different regions of the upper and lower limb. Because of the throwing sport, or cradling sport, or landing and pushing off sports, this is one that we really should have sports chiropractor become quite familiar with.

What is interesting is although the growth centers of the elbow open in that CRITOE right from capitulum all the way down, they do not close in that order. They close in this random order here. Here is your mnemonic, from trochlea to capitulum, to lateral epicondyle, to medial, to olecranon, to radius. The radius was one of the first ones to form and it is one of the last ones to close, which makes it quite significant for radial head fractures in athletes. Females precede males in fusion of growth centers, and that is good to know. If you are looking at a female athlete, she will have that growth center close first before her male counterpart. Between 15 and 19 years old, most of the athletes will have complete fusion taking place.

Here is a great example of an elbow injury in a youth gymnast where we have the radial head here, and then here is the humerus. This is an MRI. Right here, well, let us look at the medial side here. We can see that that is a nice smooth contour. As we come over here, we are going to look at this area, the capitulum of the humerus. You can see it almost looks like someone took a bite out of it. This is called Panner's disease. Panner's disease is identical to an osteochondritis dissecans in someone with closed growth centers.

If you have an open growth center and you have a necrotic area of bone on your distal humerus in the capitulum area, this is from redundant stress of this radial head hitting up against this portion, this lateral portion of the humerus. Then it causes an area of necrosis. The bone dies, starts to flake off, and then pieces of bone float around in the joint and the athlete will tell you, "I feel like my hand cannot- my arm does not extend all the way or keeps getting stuck." They have just a very vague type of pain. Once the growth plate is closed, we no longer call it Panner's. We call it OCD, osteochondritis dissecans.

At that point, we have to understand that when we have an OCD lesion or Panner's, we are going to use this term synonymously right now, there is a chance of re-injury for that, so we have it surgically corrected. Statistically, every two years they will have another necrotic episode. The intervention today is they go in and they clean this necrotic area out and they microfracture it by drilling little holes in this capitulum to perfuse it with blood and cause angiogenesis to occur. With this angiogenesis, it helps to revitalize that area of bone, and hopefully, re-profuse it with blood flow.

The interesting statistic on Panner's disease and osteochondritis, particularly at the elbow, is that in 10% of the cases, that will be on the contralateral side. Typically, before doing a surgical intervention, we will image the other side as well just to see if they have an OCD lesion on the other side. Just a heads up on that, that will be something you will need to keep on top of.

This is your osteochondritis. Here is just a regular bone in view, so that you can get a better idea if you are not super familiar with MRIs. Here is your radial head here. This is your capitulum. This is the trochlea portion of the humerus. This is from the humeral head just hitting up against that capitulum redundantly. We see this again. This is not an uncommon finding in youth sports, and they need to be removed from sport.

Some of them, if they are stable and you catch them early, can recover on their own. We want to think about modalities and treatment that brings blood flow to the area. If it becomes unstable and we have pieces of bone that have broken off, then it becomes a surgical fix where they have got to go in and have it surgically cleaned out and then microfracture. It will very much depend on the stage that you can catch this thing. If caught early enough, we might be able to reverse the process and get them to heal without surgery and just conservative care.

We talked a little bit about the throwing athlete here. Here is a medial epicondylar fracture in a wrestler. That is just right here off the medial epicondyle. You can see this is an avulsion injury. The wrestler had his arm bent back in a wrestling match, and it just popped to that medial epicondyle off. He was still growing, although he was beginning to start to close his growth centers. This is not the best picture for us to look at the growth centers, but his other image can show that a little more clearly.

We have to understand the age. This needed to be surgically corrected because this was not necessarily healing and he had several fragments. They ended up having it pinned, and this is what the post-surgical films look like here. We had a very large pin put in just to bring that medial epicondyle back into approximation of the humerus, so it can heal more adequately. In this image here, we can see his growth center on his radius still open. Remember we said that was the last to close, so it is still open. He still got some growing to go. We want to make sure that we just keep an eye on him.

When we return him to sport, it should be very slow and strategic. When we have an injury such as this here, where we lose the medial epicondyle, let us think about the other structures in that area. The ulnar collateral ligament is one, too, that provides medial stability to the elbow. That is also going to be disrupted with this type of injury, so we are going to lose stability. As we work in athlete like this back, we need to understand we are looking for that stability and strength on the medial side of the elbow before we can safely return somebody like this to sport.

Here is the ulnar collateral ligament that we just mentioned. When we have a tear of this ulnar collateral ligament, it comes in three grades: grade 1, 2, or 3. That is just right off the medial epicondyle here. Can you imagine if we were to avulse this medial epicondyle off? I would have lost this insertion. I lose my medial stability of the elbows, then the elbow can easily bend laterally. This is a great one. We can heal a lot of these non-surgically if they are not completely ruptured because they scar down quite nicely. If we treat them well, we could do a little bit of soft tissue work and instrument-assisted soft tissue. We can stimulate collagen formation and help that heal and scar down a little bit. We can regrow, so to speak, the medial stability of the elbow.

Let us talk about elbow dislocation next. The elbow is not an uncommon joint to dislocate, nine and two tenths percent of elbow injuries are dislocations. We need to be very careful and diligent when we are evaluating elbows that we are not trying to adjust an elbow. Ninety-one and three tenths percent of elbow dislocations occur in boys, probably, because they are just a little more aggressive, more participation in contact sports. Contact is the most common mechanism of injury of course, not just a fall. Thirteen and six tenths percent of elbow dislocations require surgical intervention, which is a high number. This is some of the newer research that we have coming across an elbow dislocation. Please make sure, if you have an athlete, that you are checking to make sure we do not have a dislocation

before we start manipulating or treating this elbow on the field. Checking for peripheral pulses, making sure we have good vasculature distally, and basically, we are going to splint them and get them off to the emergency department for imaging and then ortho consult for care.

The wrist comes into play with the youth athlete, this is your triangular fibrocartilage complex. This is the most common cause of wrist pain on the ulnar side. The function of that TFCC is to absorb the loads that transfer through the ulnar carpal joint. Think of that gymnast that is landing on their wrists repetitively. Let us say they have a little medial and lateral weakness. They are always ulnar deviating when they land. They are going to tear apart this TFCC complex because we need that stability on the ulnar side. Once we have a little bit of this happening because we had some muscular weakness or some inherent instability, we are going to really stress that out.

The anatomy of the TFCC is this articular disc, which is right underneath the distal ulnar here. We have this ulnar lunate ligament connecting the lunate to the ulna, and then your ulnar triquetral ligament connecting the triquetrum to the lunate. Your ulnar collateral ligament, and then your posterior radioulnar ligament, and then there is an anterior radioulnar ligament that you cannot see in this picture here. That is quite a complex that provides this radial stability.

You are going to be assessing your athlete by just having them make a fist in ulnar deviate, or you can passively ulnar deviate them. In doing that, you are compressing this complex. That, at most times, will reproduce the pain and we will know that we probably have a TFCC. We can brace. We can do some conservative care, but we need to reduce the ulnar deviated load to that area to try to get it to heal. There are quite several surgeries cultivating with the TFCC that we are seeing some good results and some not-so-good results. Let us exhaust conservative care before we move forward with any type of surgical intervention.

As we are working with youth athletes, you must understand your anatomy and the growth centers that are around the anatomy that is injured. If we are looking at the bony pelvis here, we need to remember the muscles that are significant for performance, and which muscles originate and insert around the hip. If we are just looking at this little picture here that I created, we need to... This is for your abdominals, we have an apophyseal area right here in your abdominals insert right on the iliac crest. Then your sartorius on your ASIS, your rec fem on your AIIS. Then you have your glute min and your glute med on that femoral head there.

This is your vastus lateralis, intermedius, and medialis on your femur, and then the psoas on the lesser trochanter, your hamstring and then your adductors along this pubic ramus area. What we do not see pictured here is rectus abdominis inserting right up here on the superior aspect of that pubic bone, which we see a lot for sports hernia.

The incidence of pelvic avulsion fracture. Remember, we are going to see avulsion fractures in youth athletes. That is why, specifically, we are looking at this research. This is research done by Dragoni Rossi. This is acute avulsion fractures of the pelvis in the adolescent competitive athletes. It is super interesting that we found that the highest rate of pelvic avulsion fractures occur in gymnasts and soccer players.

Your ischial tuberosity is the number one most commonly avulsed bone in the body. Number one is ischial tuberosity. Then in subsequent order, your anterior inferior iliac spine, then your anterior superior iliac spine, your pubic symphysis, and then your iliac crest. That is the order of events that we see in these avulsion fractures. Appreciating and understanding how to evaluate for them is very important. A lot of it is done with a pelvic compression test, and then palpation of the area, followed by manual muscle test to see if we have lost strength to that muscle.

Here is just a different pic, just a regular X-ray. I like to use the mnemonic A Sergeant in the Army, pictured in this slide on the left side. A is for abdominals, Sergeant is sartorius, rectus femoris, and then your glute complex, your med and min. If we are looking at the femur like clock, at that twelve, one o'clock position is your glute min, and then posterior to that is going to be where your glute med is. Then your iliopsoas is your lesser trochanter as we mentioned earlier. Number one, again, ischial tuberosity for your hamstring, and your adductors on your pubic symphysis.

We are going to palpate those structures on your athlete during your hip exams when they are supine. If they are a little uncomfortable with you palpating them in supine, put them in sideline position, and then you can more easily palpate this iliac crest, your ASIS and your AIIS. This rec fem, I found several rec fem avulsion fractures in athletes that were diagnosed as no injury at all. Just getting those palpating skills and then following up with your muscle test of these muscles will confirm your diagnosis for you.

As we talk about the youth athlete, let us talk for a minute about the difference between gender in a youth athlete. We know that injury rates among women are not different than men in general. However, there is a difference in the rate of injury for different body parts. Boys have a higher rate of injury due to their increased participation in higher risk sports. We tend to see the male youth athletes exhibit more injury and more severe injury than the female youth athlete. That is just basically they are participating in higher level of contact during sport, whereas the females are not so much.

We need to bring up ACL injuries in females and we need to appreciate that the youth athlete most commonly will occur in the female for an ACL injury. Why is that? We need to really understand and look more deeply into ACL injuries and gender predisposition for females because what we need to understand is how a female jumps and lands versus how a male jumps and lands.

A female will jump and land using her quadriceps. A male will jump and land using his hamstrings. If we think of just the origin insertion of this, your quadriceps attach on that tibial tubercle. Your ACL, the job of the ACL is to prevent anterior translation of the tibia and femur. This is your femur, and this is your tibia. The job of the ACL is to prevent this from happening. If I am landing with my quadriceps and my quadriceps are attaching on my tibial tubercle, it is contracting and pulling and shearing that ACL, so it is challenging it a little bit more.

Conversely, males jump and land with their hamstrings, and just by the sake of insertion, our hamstrings insert posteriorly on the tibia. As they jump and land, they are reducing the stress on the ACL by using their glutes and hamstrings. One thing we really can do for our female athletes is to teach them how to jump and land, and how to pivot off their foot with their weight on their heel a little bit more as opposed to their weight on their toe. These simple mechanics will help decrease the incidence of ACL tears and ruptures in females.

Also keeping in mind that 25% of all ACL surgical interventions that return to sport will re-rupture within the first year. I am going to say that again, 25% of all ACLs that are surgically repaired will re-rupture on the surgical side or on the contralateral side of surgery within one year of return to sport. We really look through the research to figure out why do we see this predisposition. Mostly, it is because we have not adequately taught them the change in biomechanics in their physical therapy regime. We need to get them doing jump and land training just as part of their injury return to sport. That should be just as important as the muscle building that is happening in our ACL recovery.

Here is some of these statistics that reiterate that fact, just done in 2021 by the way. This is a staggering number of athletes that must have a second surgical intervention. I mean, most athletes, after they re-rupture do not return to sport. That is another nine months of rehab and another surgery. We really need to make sure we do a better job in looking at the mechanics of somebody that returns to sport and that they are not jumping and landing and pivoting off their foot inadequately.

Continuing on looking at males versus females, we are going to look at some more stats and injury predisposition. If we just think of males versus females, we look at stroke volume and we know that women have a decreased stroke volume than men. Therefore, their overall cardiovascular endurance is decreased compared to their male counterparts. This is true for the pediatric athlete as well. Women have a 30% decrease cardiac output. Women have a higher respiration rate, so higher fatigability. Less total lung capacity than men.

However, even though these things are there, women have a difference in their fatigue resistance. Even though they are set up on that oxygen consumption scale a little bit different in increasing lactic acid production, they tend to have a greater resistance to fatigue. They just can combat fatigue a little bit better. Interesting that women can outperform men in cold water endurance challenges. Who knew? How do we figure that out? We know that we can acclimatize a little bit differently as females, but this is not unlike the pediatric female versus pediatric male athlete. We are going to see the same statistics.

The interesting thing with looking at cardiac differences in adolescent athletes, we need to understand if we compare the adolescent athlete to the adult athlete, with the adolescent athlete training, resting heart rate is going to decrease. When we compare that to the adult, the resting heart rate is still higher than the adult. They still have higher beats per minute than the adult counterpart. The interesting thing, too, with a trained youth athlete and adolescent athlete, we have dilation that occurs at that left atrium. Now, with comparison to an adult, we have a similar response that occurs. The left ventricle of the youth athlete dilates with mild left ventricular hypertrophy occurring. The thing about the adult athlete, we do not get that chamber dilation, but we get the hypertrophy. For the adult, that tells us the muscles working hard, but we do not have the dilation of the chamber.

We would think for the adult athlete, we are increasing the VO2 max or the ejection fraction, whereas the ejection fraction is not as robust in the adolescent athlete of equal training. For the adolescent athlete, cardiovascularly, we do see an increase in VO2 max. When we compared to the adult athlete, they have a lower VO2 max in comparison to their body size. If we look at the youth athlete, compared to their body size, they are not producing the VO2 max that their adult counterparts are producing. They have a lower stroke volume. We talked about that. That chamber dilation absorbs some of the resiliency of the ability for the heart to produce an injection fraction.

Let us move on to looking at the femoral acetabular impingement syndrome or FAI for short. We look at this research study here published in 2021 on the incidence of femoral acetabular impingement and surgical management trends over time. We think about the 1,893 patients that were studied, and 813 were diagnosed with FAI. That is a big number. That is almost half. Females had a greater predisposition, 67% than males. The incidence of the FAI continues to increase annually. We know that we have a 600% increase in surgical interventions of femoral acetabular impingement and labral tears of the hip. We have to better understand how we can protect our youth athletes from going through an FAI-type syndrome as they mature. We think about FAI and we think about compression.

Let us look further into femoral acetabular impingement. If we think about the two different types, this is a cam deformity. There are three types of femoral acetabular impingement. The femoral neck out pocketing here is your cam femoral acetabular impingement. When we have a pincer, it is an

overgrowth of the acetabular ridge here. Most commonly, I think it is about 87%, we have a mixed. The acetabular ridge is hitting up against the cam. Chicken or the egg, who knows which came first, but they both react and they both continue to grow.

Wolff's Law, reaction along the- bone is going to lay down along the vectors of force. That is what happens here and then we continue to proliferate on both the acetabular ridge and the neck of the femur. This mostly occurs with flexion, kicking activities, and change of direction type sports. We think of the youth athlete and how is this significant? We need to get control of femoral acetabular impingement and we need to get control of labral tears in the hip. We are seeing such a dramatic increase in our youth athletes with hip injuries, hip pathologies.

This surgically can get fixed, but the hip is never really the same. We must take a moment and think about how is that anterior hip more predisposed. A lot of that is femoral neck angle or inadequate training and strengthening of the anterior hip capsule, and anterior structures as well, and as well as glute med weakness. We need to take these youth athletes and train them a little bit better instead of just making them run for three different sports, maybe three games a day in soccer. We need to go back and focus on some rehabilitation of the hip to prevent these injuries.

Let us talk about our pre-participation physical examination in club sports. We are going to call that PPE, and that is for pre-participation examination. That means that is an examination that we are going to do before the season starts. Some of these youth athletes do not necessarily have a sports exam before commencing their season. Typically, as the athlete gets a little older and they go into secondary school or college, they tend to have a requirement of having these physical exams. However, that is not true for middle school and younger athletes. That is a growing population of athletes and a huge population of injured athletes. Some of these injuries can really be prevented if we just go ahead and we do a pre-participation physical exam.

I believe that is where us, as chiropractors, can really dominate and become an active role in these athletes' careers in a positive way. If we can do an assessment, a functional movement assessment, assessment of strength, global strength, proprioception, agonistic and antagonistic muscle group comparisons in the preseason, then we can fix these things before there is an injury. It might be up to you to organize a preseason screening. That, significantly, will minimize the number of injuries during the season. That is the name of the game. Let us try to prevent as many injuries as possible.

If we were to consider trying to organize a pre-participation physical exam for a group or team near you, think about these components that need to be in there. Look for predisposing factors, so getting a good health history is important. Just a note about that, if the parent gives us the health history, we are going to have a 75% chance to have more accurate health history than if we have the health history from an adolescent. Having the parent fill out the health history information is quite vital to have a nice thorough record. We want to try to use this PPE to minimize injuries during this season.

Some injuries are catastrophic. If we talk about acute cardiomyopathy, the first sign for some athletes is sudden death. Doing a PPE and including a cardiac screening would be vital in preventing a catastrophic injury. The best practice to obtain and synthesize the athlete history is to formulate a clearance to participate. In other words, in order for the athlete to participate this year, we need to have a health clearance. You can work out with the coach or the team that you are working with.

Here are the components of our screening exam, what it should include. You should have a comprehensive personal and family history. That is the most important thing. Most of our injuries, as we said earlier, history of injury, the greatest predictor is history of previous injury.

We think about vital signs. We want a resting heart rate, blood pressure, that type of thing. A general inspection of skin and posture, an ears, eyes, nose and throat examination, cardiovascular and pulmonary screening, abdominal exam. It is very important that we have the conversation with children that have a single of paired organs, in other words, one kidney. We need to talk to them about contact sports and the participation or the lack of participation in a contact sport if you only have one of the paired organs.

A neurological exam is very important. If we have neurological issues, we might have delayed reaction time, which would predispose to many, many injuries. What is the genitourinary issue? If I need to examine this, I need to have a primary care doctor there. A full and complete musculoskeletal exam is important. This way really can see deficits. Do I have instability of the shoulder? Do I have instability of the knee? How can I prevent an injury by adding some exercises ahead of time?

The best time to do your pre-participation physical exam is about six to eight weeks before the season starts. This gives you enough time to do follow-up testing with doctors if they need it, and then also time to rehabilitate certain areas if they are having some weakness or instability. A good thing to do is get a bunch of doctors together. You can get a cardiologist, a primary care physician, and orthopedist, and yourself. You can, as a group, do a one day in the office and have each athlete see each one of you, and then we can formulate a nice pre-participation physical exam. Once your athlete passes all the components of the exam, then they are cleared to play.

That personal family history is very important. It is the most sensitive tool for us to help prevent injury. We want to make sure that we are getting to know if they have a bee sting allergy, if they have allergies to dogs or cats that maybe you would be on the field. What are other things that I need to be on the lookout if they are participating in sports that could be catastrophic if I did not know.

The cardiac exam we mentioned, it needs to include all the aspects of the American Heart Association guidelines, which includes listening to the heart. It is a core component to detect heart murmurs or abnormal heart sounds. All abnormalities should be evaluated by a cardiologist. If you have a primary care physician helping you with your PPE, if there are any abnormalities, they should see a cardiologist to get cleared.

Let us not forget about these psychological considerations of the youth athlete. You must understand, as a youth athlete, they do not really have control of their environment. The coach tells them what to do and how to do it. The parents tell them what to do and how to do it. We need to be on the lookout. As healthcare professionals, we forge a different relationship with the youth athlete. Sometimes they are going to look to you for guidance, or they might confide in you the feelings that they are having. The advice you give to an injured athlete is considered active care. Make sure that you are responsible in referring to the proper person, and then also guiding them appropriately.

This also can be deemed the patient involvement phase. We can have the patient do some active care and really try to work on the psychological component. I like to call a referral in this venue a mental strength coach instead of saying, "I would like to send you to a sports psychologist." Sometimes some people have a negative connotation to that. If we could use that trend and use the term mental strength coach, that resonates a little easier with these young athletes that do not want to feel as though something is wrong with them. They could use, sometimes, somebody to talk to. They could use some tools in managing coaching pressures or parent pressures, stress of performance. It is a good idea to be on the lookout at this as healthcare professionals. We need to be ready and have some good professionals that you can refer to.

The Psychosocial Implications of Sports Specialization in Pediatric Athletes — this is a super interesting article that was just put out for us to go through. This is the journal about the training in 2019. This

specialization in sport, in other words, these athletes that are doing one sport year-round, it requires increased training hours. The athletes have some social isolation that happens. They have a decrease or decline in academic performance. They have an increase in anxiety, greater stress, less sleep, decreased family time, and hence, burnout.

We really need to appreciate that these youth and pediatric athletes need some guidance. We need to have a better hold on the pressures that we are putting on them as a society, but also parents and coaches. They need to be age-appropriate stresses. I think that makes it very difficult for us to adequately look at the signs and symptoms of these youth athletes and making sure we are looking for signs of burnout. They can sometimes be hard to detect. It is important to be able to diagnose this. They are going to display vague symptoms of fatigue, or they are not going to recover. They started having injuries that are cropping up, and they just do not seem as motivated to return to sport. Be on the lookout for this. This is a big red flag for psychological issues or psychosocial issues that are coming down the pike. We want to try to catch them before they fall, so to speak.

Concussion is a super-hot topic. We are waiting for the new Berlin concussion consensus to come out, particularly for the youth athlete. Why is it different for the youth athlete? It is because not only do they need to return to sport, but they also need to return to school and learning. We do have some stressors that are placed on them for test taking and sitting in class that maybe is not there for an athlete that is not of school age. As we are anxiously waiting for the new Berlin statement to come out — COVID has delayed it a little bit — we need to really understand and appreciate how we are evaluating the youth athlete for head injury.

A little more detailed history as two previous concussions is important. We are not going to leave any athlete unsupervised that has had a head injury. We are going to sit on the sidelines with them, and re-evaluate them every five minutes. I know we went through this in your head injury module, but it is worth reiterating. Performing those serial neuro assessments is very important. Determine the disposition of symptoms even if they are asymptomatic. We want to make sure that we have a post-injury follow-up, a return to play plan, home observation, and a hospital transport if needed.

Provide post-event instructions. Making sure we speak to a mother, a guardian, or a father, and making sure that we are giving good instruction as to if the head injury gets worse. What do we need to do? Do we need to go to the hospital? Do we need to follow up with your primary care doctor? How do we return this athlete to sports safely? As we are dealing with the adolescent athlete, we also need to understand that we got to deal with guardians or parents. Somebody is caring for the athlete. How are we getting the athlete home? Who is going to schedule the appointment to follow up with the athlete? Can the athlete get a ride back to see us? Some different dynamics as we are dealing with the pediatric athlete that we really need to consider.

Return to play. This is a return to sport strategy off of the Berlin consensus statement. We talked about this quite a bit in the head injury module. How do we want to gradually and strategically increase blood pressure and heart rate to challenge the athlete to see if they have a return of symptoms. If they have a return of symptoms, the testing is done for the day. They go home, and then come back the next day and retry again from that level.

That is the stages here on the left side. If they are symptomatic, in daily activities, do not provoke symptoms. I can try to move them to level 2 where they can do some light aerobic exercise, like walking around the track. If that increases their symptoms, they are done for the day. They go home and rest. They can come back tomorrow, and we could try the light aerobic activity again. We start them again at stage 2. We do not progress until they can pass that stage.

Where it is different for the adolescent is we have a return to school strategy, too, as part of the Berlin consensus statement. We need to understand how we guide them through these four stages in returning to school because we might have the athlete at stage one that cannot do homework or school work or should not really be reading. They need to do everything that just does not increase their symptoms.

As we go to stage two, we start to begin with school activities such as homework, reading, and other cognitive activities outside the classroom. We check to see that they have an increased tolerance to cognitive work.

Then stage three, as we start, we go back to school just part-time. As we go back to school part-time, we gradually introduce schoolwork and maybe we send them for half a day. We see how they respond. If they respond good, then we can graduate them and we can return them to sport more on a full-time basis. Then just really keeping an eye on how they are performing. If their symptoms are increasing, are they fatigued? Do they have headaches? Are they apathetic? In other words, they do not really have their normal emotions.

If we rush them back to school too soon, we noticed these symptoms take longer to get better. What we really need to do is strategically and slowly, not rush back to school activity. Return to school should precede the return to sport. We need to get back to school activity before we get them back to sport activity.

If we consider that structure is affected by function and function is affected by structure, we need to resonate with the fact that we are not all created equal and adolescents included in that, the pediatric athlete. They have growth centers that are open. Their arches are forming at different ages, muscularly. They are changing with the growing of bone itself. Muscle lags in growth, so they are intermittently getting tighter, and then looser, and then tighter, and then looser. We see lots of things that are happening differently because we have a different metabolic state in the youth athlete than the adult athlete. Things are changing all the time. We need to keep on top of this morphing of the body and work with these athletes.

As we are rehabbing an athlete and bringing them back to sport, what we really need to consider is adding sports-specific drills to the pediatric athlete as part of your recovery strategy as soon as possible in your recovery care plan. What we want to do is we want to build on foundational movements of what your athlete needs to accomplish. What type of sport are they in? How many hours a week do they need to perform? What specialty do they have in a sport?

If they are gymnast, these are a bunch of little gymnast here, are they balance beam? Are they vaulters? Are they floor? Therefore, they are going to use their muscles differently. Then also as a whole, what is their level of fitness? Do I need to work on their kinematic chain to get them a little more injury-proof, more built of Teflon, so to speak, to prevent injury later on? Maybe somewhere else in the kinetic chain. We need to cross-train them and get an idea of where the deficits other than the injury, so that I can help progress them a little bit quicker.

Look at the footwear. These youth athletes, mothers and fathers, most of the times, invest a lot of money in shoes because they are ever growing and changing. They would be buying expensive shoes very frequently. That puts our youth athletes at a very high risk for injury, but also a lower performance. Shoes are very important. Adequate footwear is very important for performance, but also injury predisposition. Get the shoes that they commonly practice in for the youth athlete. I want to see what the quality is of the shoe? What is the parent buying this athlete? Is this just an off-the-shelf Target type of shoe, or we have a nice running shoe from a running store? Let us look at the wear patterns.

Not unlike the adult but understand where patterns might change as an athlete grows. Shoes might get tighter, and they might change their gait pattern. We need to appreciate and be ready to evaluate that, and that is a little different than the adult athlete.

Ask the youth athlete about taping or braces. Did a coach tell them to wear a brace? What about past injuries? Again, we cannot reiterate that enough. Then we are going to ask them about foot or ankle pain, hip, or low back pain. The pediatric athlete is not the best communicator, typically, and they are not good historians. We need to be ready to ask the questions because they are not going to necessarily offer the answers that we are looking for that would help us better treat them. Making sure that we are a little more inquisitive with the youth athlete and a little more communicative on our part as healthcare providers, so that we can extrapolate the best information from the athletes that we can better treat them.

Pull your picture together, and I always say, retest your theory and retest your theory because pediatric athletes are ever-changing in height, weight, size, and performance, and how many hours a week they are practicing or not. We need to keep on top of them. They need to be a regular patient, so that we can prevent injury.

Looking at that shoe wear pattern, making sure they are tying their shoes. This makes me crazy when someone does not tie their shoe. These are the shoes of somebody who is a youth athlete who wore them for four years straight and never changed his shoes. From the shoes he wore to school, to the shoes he wore to football practice, to the shoes he wore to church, same shoes. We need to understand and appreciate that. Sometimes we are going to have to educate the parents as to what an athlete needs. Just because they are young, it does not mean their needs are different than a more mature athlete.

Making sure we are looking at the inspection. We are inspecting the shoe from all angles. I like to look at the back of the shoe, the top of the shoe. I like to look at the bottom of the shoe, like we just looked at in the last slide.

Making sure we have them putting on the shoes they wear for practice and doing functional movements. I like to get my athletes on the treadmill walking or on the ground if they are not used to a treadmill. I want to see how they squat, bend, jump, land. We want to see them in the shoes that they wear for practice now. If they are in a sport that is not a footwear sport like dance or gymnastics, then we want to see them doing these tasks without shoes on. That is important.

When does the return to sport plan begin, as your youth athlete? How is that different than the adult athlete? What is your measure of readiness? How are you going to progress and return the athlete to play? Also, what is your timeline, the level of play, and the measure of injury would demand at sport for that region? What we need to really understand is as we are getting somebody to return to sport, that youth athlete, what position are they going into? What is the terrain they are running on? Are they running on a track? Are they running on grass or turf? What type of footwear are they going to be wearing? Let us start our whole return to play plan as early as possible and start instituting a kinetic chain strengthening exercises, so that we can prepare them for their return.

What we have to get away from is over-immobilizing or over-resting the area instead of training the other areas to get stronger around it. I guess the best explanation is we can have a runner who cannot run maybe jogging in the water with a vest on so they can float. For a runner who cannot run due to stress related injury in the foot, maybe we can work on hip flexor strengthening, maybe we can work on balance on the other leg, maybe we can work on lumbar extension strengthening exercises, stability exercises. Thinking about other ways to keep them cross-trained is important, so as they return, they

have a smoother transition back into sport with strength as opposed to now they have got to start with an amount of global atrophy through their body. We want to prevent that.

Let us know what is normal for your patient. As you are looking at athletes, you need to understand what is their range of motion, and what do they need for their sport? What does this athlete need from his hip in order to do his activity? What range of motion would be normal? Most importantly, as I am considering the care plan, what type of muscle fiber does this athlete need? Is it a gymnast? That is a fast-twitch muscle fiber type of athlete. Is it an endurance runner, or distance runner that is a slow-twitch? My care plan needs to facilitate the type of muscle fiber recovery as well. We do not want to be out-training from sport by taking our fast-twitch fibers and making them slow-twitch by having are bursting gymnasts do a long-term endurance activities in the recovery phase. That is an important consideration.

Let us take the time for all our injured pediatric athletes to teach them how to stretch well. That is a life lesson that will carry them through a healthier body all the way through their athletic career. Take the time to teach them the difference between dynamic and static stretching and when they might want to do them. When is the right time to stretch? We want to teach that pediatric athlete how they want to stretch when their bodies a little bit warm versus when it is cold? How long did they need to hold each stretch? We need to get each pediatric athlete that you are treating more educated, so that then, they stay healthier and healthier over the years.

Also understanding that we have different phases of care. What is appropriate as you are treating the pediatric athlete and how that might be different than the young adult athlete or the masters athlete. Some of these might be different, but again, these phases of care for the pediatric athlete, they might move through these phases of care a little quicker because they have a higher metabolic turnover. Just be on the lookout. They might get better a little faster than everybody else.

Still in that acute phase for the pediatric athlete, we are still going to do our rest, ice, compression, and elevation. I know there is a lot of discussion on ice. I have moved away from ice quite a bit. Most of my injuries, however, in the first 24-48 hours, I still do ice. If there is still a good amount of swelling at that point, I will go one more day to 72 hours and then I am over to heat. By day 3, I am not using ice anymore unless there is a lot of reactive edema at the end of each day.

Your mission in this acute phase is to decrease edema. That is what your mission needs to be. Take your youth athlete and let us educate them on why that edema is so critical to get rid of, how they are going to do that, and why they need to take control. We are teaching our youth athletes to take control of their body and learn how to manipulate their body in their favor. This way, we are going to run into healthier adult athletes and understand the safety in different types of braces. Make sure they are not wearing their brother's or sister's brace that does something different than the injury that they have. If they are using crutches, we are educating them on how to use the crutches appropriately.

Understanding the progressions. As we are teaching these youth athletes stretches, how are we going to progress them? They are going to be moving quite quickly through your rehab. We want to stretch all four quadrants that, say, for stretching a hip. Let us teach them a bunch of different ways to stretch. It is really quite a nice advantage to take the youth athlete and educate them because they become superior athletes.

In your subacute phase, we are going to start working on muscle synergy, contraction, and proprioception. We are going to always continue with edema reduction. We are going to continue and we are going to be striving for range of motion. We begin our range of motion as soon as possible, most times by day two. After an injury, we have them start going through the range of motion in that

body part. That is going to help facilitate decreased edema in the area as we are increasing range of motion.

We cannot progress them to sport-specific activities without full and restored range of motion. That is most important. Getting that edema out of there so that we can start with strengthening stuff is very important. Your subacute phase is continuing with the edema reduction and beginning muscle contraction. We are not doing tons of strengthening yet because we do not have full range of motion, but we are starting with some light-level range of motion type activities.

In our late subacute phase of care, we are moving into a full range of motion. We are beginning our strengthening. As we start getting range of motion, then I am starting to strengthen. You do not want to necessarily over-strengthen something that does not have a normal range of motion. Then we might be limiting attaining that normal range of motion.

For the youth athlete, we are going to take our time and walk them through with a little more detail, teaching them proprioception, stability, and safety, and progress them away from crutches or out of a sling if it is an upper limb problem. We want to understand this late acute phase is a big transition from simple, more passive care to more active care. By the end of the subacute phase, we want them in an active care model.

We need to start thinking about assessing the kinetic chain as your athlete starts to perform, as your athletes to improve through your phase of care. Now, the adolescent athlete, this is a great opportunity for us to pick up some kinetic chain weaknesses that we can fix and send them back to sport. Understand, your first step in assessing the kinetic chain is an accurate diagnosis first. You have got to get that accurate diagnosis, then we can assess functional.

We cannot really do a ton of functional movement assessments until they can walk, jump, or squat without a limp or without trying to dance around the pain that they have. If they have a primary complaint, that is an acute injury, we must first work through that a little bit. When we are ready, check the functional motion. However, conversely, if it is an athlete that comes with just a quirky something, that is not acute onset. It is more insidious in onset or gradual in onset. Then we are going to think about doing that functional movement the first day, and assessing squatting, posterior chain tightness, heel raises, and all types of gait analysis and whatnot. Our goal is to fix the primary complaint and fix the kinetic chain in the youth athlete because we are really protecting that youth athlete when we return them to sport then.

Why do we worry so much about the kinetic chain and why is it such an important part of rehab is because we have a decreased joint load when we have an effective kinetic chain. When we have a dysfunction in the kinetic chain, we have increased stress on the distal segments. We are going to reduce injuries if we check that kinetic chain before we send them back to sport. If we send them back to sport half-broken, then they will come back to you broken again, the goal is injury prevention.

We think about this kinetic chain and how I might look at it. If we are just looking at this region here, I want you to look at just the first row and let us just look at the sagittal plane. I want you to ignore the last two rows, this frontal plane and transverse plane. Let us ignore these two rows. Let us look at the effects of pronation and let us call it hyper pronation. If we think about just pronation which needs to occur in a normal gait, we have to think in the low back. Your back goes into extension with normal pronation. Your pelvis has to rock anteriorly. Your mid tarsal joints all need to dorsiflex.

If we think about the frontal plane, you have to laterally flex the same side and the transverse plane, your low back, has to protract. The pelvis has to translate and has ipsilateral elevation. On the

transverse plane, your pelvis must rotate forward. All the mid tarsal joints must go through abduction and all the mid tarsal joints have to go through inversion in the frontal plane.

Lots of things need to happen with pronation, however, with hyper pronation, this happens in excess, this cascade of events. We think about inserts and whatnot for the youth athlete. It is important. Some of the insides of these turf shoes are just an empty shell. We need to offer our athletes a little more assistance, so an off-the-shelf type of orthotic is not a bad idea at all. That might significantly help us prevent a bunch of injuries by improving the gait cycle and increasing the power generated through the kinetic chain.

Because what we need to understand is the functional anatomy. Not only are we looking at the intra-articular structures, the ligaments, tendons, muscles, and fascia as we work from inside out, but we are also looking for the athlete in a different way. How the bone might grow, lengthen, and what happens to the muscles in that way? We need to really be thinking about the layers of anatomy, but how is this different in the pediatric athlete? How is the bony structure different? We talked about apophyseal injuries. How is the connective tissue different? We talked that the bony insertion, the bony attachment is weaker than the connective tissue. Therefore we have apophyseal injuries because the bone comes off because the tendons are a little bit stronger than the bone.

We need to talk about how the muscular compensatory layers are a little bit different in the youth athlete than the adult. Same thing with intermediate and superficial layers, and then fascia, too. For that pediatric athlete, they are not different in many instances than the adult athlete fascially, but we need to keep them healthy. We cannot just assume they can play three different games of soccer in one day. We need to understand they need to recover as well. Their bodies need to recover.

Looking at gait of the pediatric athlete is important because sometimes we can truly appreciate where we have breaks in the kinetic chain. We can learn to fix these early and prevent a whole bunch of injuries. If we look at this athlete here, just in this step position here, you can see her left foot is quite turned in. She actually has an over-facilitated posterior tibialis tendon and an inhibited fibularis complex here. This stress in this type of a gait left unfixed for this youth athlete will cause anterior head compartment to eccentrically contract and increase the load on that anterior hip a little bit more.

As your heel hits down and you start to swing through, this is the phase that we have a lot of anterior hip forces. What we need to think about is getting that gait to improve in these youth athletes. Correcting these gait abnormalities is critical to prevent a whole host of injuries that happen intraarticularly and extra-articularly.

If we think about gait and we move on to the knee, we think about knee flexion creates a smooth transition with the contact to the foot. We need to have normal range of motion of each region, of each joint from the lumbar spine down to have normal gait. If we have an abnormality like in this picture here, where I have already started my gait pattern faulty, then I am having faulty stresses placed on the knee, the hip, and the lumbar spine as well. We need to think about that correction myopically will fix the whole kinetic chain.

This is my most beautiful artistic rendition of muscle contraction that occurs during the stance and swing phase of gait. For the youth athlete, we need to appreciate how are we getting our strength as we go through the gait cycle. We think about training these young athletes. We need to make sure we have strength training that can occur, so that they can adequately facilitate the use of these muscles.

Let us just think about hip adductors here. Look at how long along the gait cycle right here that this needs to contract. That needs to be an endurance-trained muscle. Appreciating the gait cycle between the stance phase, the phase your foot is on the ground or made contact to the ground, versus the

swing phase, which is the green at the top up here. When your leg is swinging through your gait, we can see that we need a lot less robust use of the muscles, the large muscle groups around the hip region, and knee region than we do when we put our heel down and start propelling ourselves forward. That particular use of these muscle groups is important to appreciate, and also, so we can adequately trained our youth athletes. If we are running, then we need to generate this force in a shorter period of time. We need to train our athletes, our youth athletes, appropriately.

When is it appropriate to start strength training in children? There is a lot of debate about this in our pediatric athlete. If we scroll on any of the social media applications, we can see some of these young kids squatting and lifting weights and whatnot. I do not know how everybody feels about that. Back in the day, they used to purport that it closes the growth center prematurely. I have read research on both sides of the fence on this one. I like to say it is better to start your strength training and your rehab as possible. Let us just be smart about it. Let us just make sure we are tuning into the athlete and what they really need, what their body needs, and let us slowly and strategically increase the load and force in which we are demanding that strength from them.

What are your limiting factors? Are they limited by range of motion? Are they limited by intensity? What are they limited by? For the pediatric athlete, different considerations as we start instituting a strength training program. When is it appropriate to progress? We need to have that strategic stepwise progression where we are gradually increasing loaded intensity as they are able to complete a task. If we can walk without a limp, that means we can do walking activities. If we can run without a limp, that means they can do running activities. If they can do strength training with full range of motion without pain and inflammation, then they can add in their strength training. I typically like to give an exercise and see how they fare with it over 24 hours. When they come back, if they are not sore, worse, or inflamed, then I add more. I strategically like to keep adding that way.

We talked a little bit about introducing sport-specific drills and how important it is for us to introduce these sports-specific drills early on in your training program, but we need to build on foundational movements with the sport. Also, we need to work on timing, athlete reaction, and anticipation. We also need to cross-train them to gain control of other body parts. We cannot always myopically just train somebody for one sport. We are globally missing the boat if that is the case. We need to have our pediatric athletes cross-trained. If we look at this graphic on the right bottom from Jill Cook out of London on her research on tendon load and tendon reintroduction, graduated returning to running program.

With the tendon injury, we always are going to start here with our isometric work first. A real tendon condition is a condition of necrosis to the tendon. This tendonitis type term is an older term. What we want to think about is that with a chronic tendon issue, the tendon is in a necrotic state that blocks the blood flow to be healthy. We need to introduce angiogenesis or blood flow slowly and strategically to the area during our rehabilitation phase.

We are going to start with isometric work, then we are going to go into strengthening, and then more functional strengthening, then speed. We are not going to add speed till later. Plyometrics are going to be added last. It is very important that we pay attention to the stepwise progression. We are going to gradually increase intensity, volume, and frequency over time. This gives the tendon a chance to hypertrophy. Just like we are waiting for the muscle hypertrophy. If we overload the tendon too soon, we will have a re-injury for sure.

If we can look at this picture here of these athletes running, I like to point this out because we talked about the kinetic chain and what I might want to work on. I am always looking at movement, how everybody is moving, and how their bodies are performing. If we can look at this athlete here running

and see how she has that what we call triple extension in running, hip extended, knee extended, and your foot extended. That triple extension is important for good forward propulsion.

We can we see this athlete here is lacking a lot of triple extension and she is more collapse on her body, more promoting lateral motion or slowing of her forward motion versus forward motion. No surprise that she is in last place of these athletes running here. We think about watching the movement of your pediatric athletes and seeing, retraining them for an injury care plan path. Let us retrain them so that we can send them back to sport and improve more injury-resilient athlete.

We talked about pronation and hyper pronation. In the youth athlete, again, that footwear is critical. Making sure that we decide if we need an orthotic, or an insert is appropriate. As we get them in an insert, let us take that pediatric athlete back to the office with their shoes and their insert and let us watch them walk in it. It is very important that we establish a patellar neutral position. We also allow a little bit of pronation. We see that excessive pronation is most common in running analysis, while most of these youth athletes are in running sports. Soccer, lacrosse, track and field, football — these running sports need to have adequate foot structure support as well, so a good shoe. If needed, if their arches have not formed adequately by age seven, then we need to maybe offer some support such as short foot exercises, put intrinsic muscle strengthening, spread your toes type of activities to help build that strength up. We are trying to take the youth athlete and make them healthy adult athletes.

With hyper pronation, we get an increased demand on muscles, which makes them work harder and that is along the whole kinetic chain. Just trying to fix this hyper pronation with doing your foot exercises, or if they need to use an orthotic while they are building their muscles or their intrinsic foot muscles back up. We need to think about we are preventing a lot of overuse and stress on the lower limb. With excessive pronation, it also promotes excessive internal rotation of the tibia and femur. This is a patellofemoral maltracking issue, which is the number one most common injury in all age groups, all people, athletes and non today. We need to look at the foot structure in the early stages.

As we are looking at our pediatric athlete's gait, we need to understand that this is the controlled fall that occurs during gait analysis. What we need to really appreciate is that your foot needs to dorsiflex 10 degrees. We need to get it up at least 10 degrees. We need to get that great toe at least 30 to 50 degrees in extension. The tibia needs to internally rotate it. If you step down, your tibia is going to internally rotate. Your talus must evert and then your foot pronates. That is a controlled step. These things need to happen.

Also, with a pronation, we need to plantar flex. Extend and rotate, invert, and supinate. Now, we are dropping down in our gait here, and then we must do the opposite to recover. That is your bottom one. This is the step down here, and then this is the swing phase. We are going to talk about here. Accepting load in the top row, and then swinging through. What happens to your foot? Your foot is going to supinate. Your leg is going to abduct as you swing your leg through.

Always remember, for your pediatric athletes, make them part of your team. Give them homework to do. Make them part of active recovery. This is an unfair advantage that we have when we are treating pediatric athletes and youth athletes to teach them about their bodies, to teach them about how to care for themselves. This is a life lesson. Have them become an active part of the recovery, so that they can gain this knowledge and become better athletes, and again, more injury-proof as we go. I like to give all my athletes two homework exercises each time they come in. That is their homework so I see them back again, and then I will progress that. This keeps a nice active response in the recovery phase.

It is very important as we are working with pediatric athletes that we consider safe sport. Now, in the United States, we have something called the U.S. Center for SafeSport. Basically, this is training and education for the coach, the athlete, and the parents. For a very nominal fee, I think it is $24, you can get certified in Safe Sport. In the states here, to work with some level athletes, you need to be SafeSport-certified.

I strongly recommend it. It is a great education on what is the appropriate and not appropriate procedure when working with an athlete and when observing a coach working with an athlete.It is a great resource for parents to become acquainted with what should happen to athletes in practice, and what should not happen to athletes in practice. I encourage you to spend just a little bit of time getting SafeSport-certified. It does not take long at all. You can do it on the computer from home. You will really have an unbelievable knowledge of what the athlete goes through. Also, let us encourage some parents to get SafeSport-certified, so that they can know what to look out for. We can prevent a whole lot of youth injury predispositions or unfortunate circumstances if everybody was more educated. Everything begins with education.

As we are working with youth athletes, we need to make sure we take command of things such as helmet fitting. If you are working, whether you are working with American football, lacrosse, or any sport that is using any type of head gear or mouth gear, please know how to fit it appropriately, know the steps that are needed to make sure you have a fit, know how to inspect that equipment on the inside and out. Know when, for American football here, the bladder could be deflated. We had one athlete in town here who reported to his athletic trainer that his helmet did not seem to fit well and the athletic trainer said, "I checked them all. You are fine." but did not take the time to check the athlete.

The athlete came in again the next day and said, "No, no, there is really a problem with my helmet. It does not feel right." The athletic trainer, once again, said, "Your helmet is fine. Stop being neurotic. Go home." The next day was a scrimmage. He had a traumatic brain injury. When they looked at his helmet, the bladder on the inside of the helmet was broken. The athletic trainer did not take the time to assess the equipment, even though he was asked two times by the athlete. Therefore, he has a very large lawsuit to the school system and the athletic trainer as well. Unfortunately, for this athletic trainer, the father of this athlete was a lawyer, so he did not bode well. Very unfortunate brain injury there, that is for sure.

Know how to inspect it, know what abnormal looks like, and know what normal looks like. It would not be bad to teach your athlete how to inspect their own, it all begins with education. When we are dealing with youth athletes, that education is a critical part of what we do.

When we talk about mouth guards, same rules apply. Know how to fit them and know how to know when your athlete has a good fit for a mouth guard versus a poor fit for a mouth guard. What we do know is that mouth guards can prevent a lot of oral facial injuries. It is an important component and a necessary required component, the uniform for many athletes. Please note, take a little time to read about mouth guards and understand a custom mouth guard versus a non-custom mouth guard and the advantages for your athlete. What about when these youth athletes have braces? How does a mouth guard fit differently? Do I need to get a different type of mouth guard when they have braces versus none?

Here is a little bit of research on the effects of mouth guards on performance. What we notice is a neurophysiological feedback and mechanism. We have increased performance with mouth guards, which is actually pretty interesting. We do see repositioning of the mandible, and the patency of the

nerves and arteries in the TMJ is improved, increased blood flow and perfusion of oxygen to the tissues, which may improve function.

One thing, I have some fun with it, have your athlete put their mouth guard and muscle test them. You will notice a big difference when you muscle test them when they are biting down on their mouth guard versus without a mouth guard in. They will be stronger. We notice this. Therefore, a lot of professional football teams take a good amount of time to make sure we really have a good fit for our football players for their mouth gear because we can exhibit greater arm strength with effective mouth gear. If we are talking about a lineman that is trying to push the line back, I could probably make sure he has a better mouth guard so he can perform better.

It all begins with the youth athlete and education. Not unlike protective wear, some of the youth athletes are going to feel self-conscious about wearing certain types of protective lenses. Let us work them through that. Let us give them options. Let us help with the fit. Let us make sure that those glasses are not going to go flying off during a gymnastic event. While running or pole vaulting, let us make sure they are secure on there, and they are at the right type of protective eyewear made of the proper material so that they do not get injured.

Practice conditions are a very important consideration, particularly for the pediatric athlete, because they do not necessarily have control. We talked about this a little bit. The coach is going to tell them that they have got to go out and practice or even though the gym is only 50 degrees, they cannot wear sweatpants or a sweatshirt. We need to educate the athletes as to what appropriate practice conditions are. We need to educate the parents as to what appropriate practice conditions are. We need to also be ready to intervene ourselves as to appropriate practice conditions.

The same thing as temporal aspects of fueling. I worked with a team not too long ago that would not allow sips of water in a four-hour span. They said it decreased performance. The coach said, so the athlete has no control in other words, the youth athlete. We need to empower them, but we also need to be there to protect them and educate the parents so that they can better protect their children. Sometimes they are just doing what the coaches tell them to do as well.

That moves us on to our hydration of males versus females. What about the youth athlete? We know that women have a lower sweating rate than males. Same thing for the youth females. We know that there is a sex difference in renal water and electrolyte retention. Women are at greater risk than men to develop exercise-associated symptomatic hyponatremia. That also applies for the youth athlete. Just because they are young, it does not mean they can always acclimatize adequately. Just because you are young, it does not mean we have a level playing field for males to females. We need to make sure we are offering proper hydration to these youth athletes, educating them as to proper hydration, educating the coaches and the parents. I am not going to say that too many times at this lecture because I really want to drive home the fact that we need to protect these youth athletes.

Here is interesting research in 2021 by hydration and adolescent athletes that was put out. The results showed that 20 to 44% of the youth athletes were identified as hypo-hydrated, with 21 to 44% and 15 to 34% of athletes commencing low and high intensity training in a hypo-hydrated state. This is done with elite level athletes here. They notice that a third to just below a half of them are all exercising without enough hydration. Let us think about, physiologically, what that does to the fascial planes and the ability for fascia to compensate and glide because that needs to be hydrated. Let us talk about metabolically what happens to these athletes out in the heat, that are under hydrated. Everything is going to go back to education and empowering you to empower them as to adequate hydration.

Relative rest is an important term for the youth athlete as we are trying to get them through a care plan. What we need to do sometimes is make sure that we maintain training, but we might have to be

a little creative. I like to think this is the artistic component of working with an athlete. It is how can I keep them kinematically trained? How can I maintain kinesthetic awareness, balance, proprioception, and strength while working through an injury? It is easy for me to send somebody home in a brace and say, "Do not do anything for six weeks and come back." But is that really the right way to do it if we want to send them back to sport without a chance of re-injury? It really is not. We need to be a little bit more rehab-savvy there and we need to think outside the box.

This would be an example of a ballet dancer with stress injury in her foot, that she is not able to bear weight. We can have her do a dance class on a what we call ballet mat and have her do them, so that she is not putting weight on her feet. We can put her in a pool. Understand that we have to allow healing of the injured area but let us cross-train all the areas so that we do not lose strength, we do not lose tendon girth, and we do not lose proprioceptive and kinesthetic awareness.

When we work through this art of relative rest, what we have to decide is we have got to decrease the duration or the intensity and type of exercise or the number of repetitions. It might just be that simple. It might just be that you have got to cut back 50% on training. However, we really need to consider the injury, the safety of the athlete, the type of injury it is, and the likelihood of it getting worse if we do not stop activity. This is very much an artistic component and really, as you work with athletes more and more, learning what is appropriate. When in certain injuries, I need to pull back on. Some injuries I can still train through but decrease my intensity.

Understand when can I switch to non-weight bearing activities in order for them to get better? Can I cross-train the upper body while the lower body is healing? What about visualization? Visualization is huge for maintaining performance. Then some type of sport participation — watching practice. I like to get them to practice, sitting on the sidelines, listening to the coaches' feedback of the athletes out there, just keeping their head in the game. This is also good for psychological component of healing as well.

When we consider the pediatric athlete as a whole, I want you to come away from this lecture really understanding the difference between the pediatric athlete and the adult athlete. We need to think about preseason screening because we could have congenital anomalies that nobody has picked up on yet that we might find. Also, we need to consider and look at how we might assess an injury differently. Let us talk about growth plates. We talked a lot about that today. In the elbow and around the pelvis, and now, we have an increase in growth plate injuries that are significant. A good number of percentage of pelvic growth plate injuries, such as hamstrings of the ischial tuberosity.

We need to understand these predispositions are also prevalent in certain sports. Males versus females, contact sports versus non-contact sports. Let us look at the parent and guardians. We talked a lot about that.

If we could come away from this lecture with anything, I would really like to resonate in the fact that we have a responsibility to educate the parents and guardians towards good practices at practice. What is a good environment for practice? When is their athlete hydrated? When does your athlete adequately fed? Different types of nutrition. What about footwear that we talked about? Practice environment, coaching situation.

We need to think of all these things as we consider our athletes. We need to educate those athletes that they take control of their bodies and that they can learn how to care for themselves. The safety of the athlete is above everything else. It is all about preventing injuries. That comes with educating the parents, the coaches, the guardians, and the athlete, and cross-training them so that when we return them to sport, we return them stronger than they were before. We have some guidance for the

healthcare team. This means that maybe we need to educate the healthcare team as to what is happening because we have seen breaks in that chain as well.

Thank you so much for taking the time to learn about the pediatric athlete with me today.

If anybody has any questions or issues, you can find me on my contact details below. Good luck getting your ICSC.

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