

ICSC01 Head Injury in Sport – Section 1 Sports Concussion 2023 Update Scat6

ICSC01 Head Injuries Section 1 – Sports Concussion Update 2023

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Video Lesson: 02:22:03

Welcome everyone to the Head-Injuries Annual Update. What this update is going to serve, is two purposes. We have got people who are already qualified with their ICSC. There is a requirement that they update their Head-Injuries Module every two years. This module will serve a role for the group that has already gotten their ICSC, this will be their update. Then we have got the group for those practitioners who are seeking to become ICSC qualified and achieve that ICSC certification. As part of the certification process, there is a Concussion Module which is what we are doing here now as the online component. Plus, during the hands-on, there is then a hands-on Clinical Application and Assessment of what it is we are going through today.

For those who already have their ICSC, this will be the update of the latest information. We are very fortunate to have had the Consensus Papers of the 10 systematic reviews, the consensus statement, and the 5 new tools that have come out, SCAT6, SCOAT6, Child SCAT6, Child SCOAT6, and the Concussion Recognition Tool. It is a very current update and looking forward to being able to share this information with everyone.

As we go through it, I will try to the best we can to separate it for the people who had doing the hands-on material. We will emphasise when this material where we are expected to know as the prerequisite before we get into the hands-on. That way we know what we should be studying, revising, and practicing before we go into the hands-on module and do our assessment at the actual Symposiums of the particular courses.

My name is Brett Jarosz, I am a fellow Sports and Exercise Chiropractor and Neurorehabilitation Chiropractor in Melbourne, Australia. My main thing is private practice here in Melbourne, Victoria. I also serve as a role as part of the Allied Health Team for the World Surf League.

The Disclosure from FICS. FICS makes every effort to provide contemporary information. Obviously, this module, is very contemporary, being only based on material released in June 2023. Hopefully, everyone gets a lot out of these next couple of hours plus in the hands-on for the new learners. FICS desires to build the best of the best in International Sports Chiropractic. I am hopefully demanding a little bit more from everyone in the field of Concussion. I will emphasize those sections throughout this presentation of how I would like to see our group become better and be some of the best practitioners in this particular space. FICS and their instructors are vetted by the FICS Education Commission, composed of academic members and leaders from most regions of the planet. The information instructed by me today has been established and approved by the FICS Education Commission, and FICS will not be held liable for any injuries as a result of today's instructions. The majority of the material, what we will really be covering today is about assessment. That will be the overarching aspects of what we would be doing hands-on when you attend the Upper Extremity Seminar. We will also try and go into some aspects of, we call it Management for now. We will discuss some of these rehabilitation aspects later on, with those differences and nuances coming into play as it relates to Concussion.

The objectives of this presentation are, will go through the definition of concussion, the updated definition, and you will see there are still some issues with the actual definition. We will go through the Pathophysiology of concussion. We will go through of course, these new aspects that are going to be important for our Sports Chiro practice. If we are working sideline at an international event, such as the World Games or other events with FICS Sports Chiro practice, part of that team, or maybe the sole provider there, we must understand these things there that are in blue. **The SCAT, SCOAT, the Return-to-Learn, Return-to-Sport.**

In the last bits in the end, there are going to be questions that are potentially that will be coming up from patients down the track. We just want to be across some of those topics, so that we can be better informed in our communities, in this particular Concussion space.

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We will start here with the two groups here listed in the yellow list. The Concussion definition and the Pathophysiology. If we just look at some occurrences of concussion, everything, as for everyone recognizes that I will reference every slide where possible. Those references are at the end. If you want to go in and see the details and get further material out of that, all those references will be there for you in the final few pages of this presentation.

A concussion is among the most commonly occurring injury in sports. Globally, there is a one in five-lifetime risk of concussion. When you start to hear that number that's up there, one in five, an estimated 3 million people, 50% are children and adolescents, sustain a concussion in North America annually. This is the important part, the majority of the concussion research comes from North America, the United States, and Canada. There are some that come from Europe, Scotland, I can think about with professional soccer, football. Limited but growing research coming out of Australia, with also football and rugby but the majority of the literature that we have with concussion, really big databases of this information comes from the US and North America. Of those 3 million people in North America that could get a concussion every year, 30% of them have recurrent concussions. They have had a concussion; they get another one. Then 30% remain symptomatic for more than one month. We will go through these definitions a little bit later on. Basically, that idea is becoming or remaining symptomatic for more than one month is where we are starting to get into realms of trying to separate concussion injuries versus persisting symptoms and how we want to look at these things differently. We will go through that throughout the course of this presentation.

Sport-Related Concussion when you see SRC (Sport-Related Concussion) reportedly accounts for 36% to 60% of concussions in children and adolescents. Children Adolescents, the basic ages for that, children would be said to be 5 to 12 years of age. Adolescents would be said to be 13 to 18 years of age. That pediatric population not including, obviously, the 0 to 4 age group here but 5-12, 13-18, you can see that the majority of Sport-Related Concussion is occurring in this age group. In Canada, one in nine adolescents sustain a concussion annually.

The concurrent concussion definition. The Concussion in Sports Group meets every 4 years to come up with a consensus statement. Now, because of the pandemic, the original consensus statement, although the consensus meeting was supposed to have occurred in 2020 got delayed until 2022. The meeting occurred in Amsterdam in October of last year, October 2022. The Concussion in Sport Group, the Expert Panel, you can attend the conference as an attendee for 2 of the 3 days, on the third day the Expert Panel is basically in a locked door room going through the research, and the evidence. They are debating, arguing, and voting for things. If we look at what is written here, in preparation for the Amsterdam Concussion Conference, the Scientific Committee considered that the Berlin definition, which was the definition from 6 years prior, should have been 4 years but 6 years prior, they considered that the definition that they had from Berlin required modification to align with more recent scientific evidence relating to advances in our understanding of Sport-Related Concussion pathophysiology.

Research evolves, science evolves, and as our understanding evolves so do our definitions, our management strategies, our assessment strategies. All of it has to continue to evolve. We will see that there are similarities, for those people who currently got their ICSC, you will see a number of similarities that have continued from when you have done this material a couple of years ago. For the new learners, this will be new. At the same time, we will see for the people with the ICSC already, you will see what things have been updated into this new consensus, SCAT6.

The conceptual definition and this is where the consensus statement in the Concussion in Sport Group becomes important because for them to achieve consensus they need to get an 80% consensus vote from their Expert Panel, which I believe is 28 people. They need to get an 80% agreement in order for something to be put into the consensus. The conceptual definition was accepted but as a majority decision, because it was 78.6% but not reaching an 80% consensus. The definition that now is currently in play, for the definition of Sport-Related

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Concussion is that it is a traumatic brain injury caused by a direct blow to the head, neck, or body resulting in an impulsive force being transmitted to the brain that occurs in sports and exercise-related activities.

Symptom 1, where I just want to get a visualization concept for everyone, is I want you to take that first line and realize that I do not need to get hit in the head in order to have a concussion. I could take a blow to my chest or somewhere in my body, for example, and then my head gets thrown. That impulse gets thrown into my brain, through that impact through my body. Let us use an example here to sort of define this. I was driving my chiro and I got hit from behind. I have that acceleration-deceleration injury that we then call, whiplash. Let us break that down, the mechanism was an acceleration-deceleration injury that occurred to my neck, and we call that whiplash. A concussion is an acceleration-deceleration injury to the nervous system. If we can visualize that as a concept and look at that first sentence again it is a traumatic brain injury caused by a direct blow to the head. If I get hit, this gets accelerated-decelerated, or get hit in the neck, accelerated-decelerated, or to the body, accelerated-decelerated, that impulsive force is transmitted to the brain that occurs in sports and exercise-related activities.

Naturally, some, hopefully, a lot of you guys, would be thinking, therefore in a concussion you can have a whiplash but hopefully, when you flipped open a yellow light, if you have a whiplash injury you can also have a concussion. As this presentation evolves on we are going to start to realize that if you are dealing with whiplash and/or dealing with a concussion, you are going to have to start to learn that we have to assess a lot of things. It is not just the neck, and it is not just a couple of little brain tests. We have got to assess a lot of things.

That particular force being transmitted to the brain, sentence 2. This initiates a neurotransmitter and metabolic cascade, with possible axonal injury, blood flow change, and inflammation affecting the brain. Conceptual here, again, for everyone. I want you to view sentence 2, neurotransmitter, metabolic cascade, axonal injury, blood flow change, and inflammation. I want you to view that sentence alone. I want you to think that is a concussion. Think of it just like if I tear a muscle, I get a bruise to a muscle, a hematoma, the inflammation that occurs, all that healing process, will just be the same thing going on with the brain. When that comes in, you have got a concussion, and when that inflammation, metabolic cascade normalizes, the blood flow returns to normal, and the concussion is over. This is an important part. We have a couple of slides on this coming up. I want you to view that that sentence, sentence 2, that is what the concussion is. This inflammation within the brain.

The symptoms and signs may be present immediately, or they may evolve over minutes or hours, commonly resolved within days but may be prolonged. They are generally there immediately, and the tricky part with concussions is someone may get what looks like a concussion injury. The athlete or person that is not playing sports has a fall, for example. We are talking about sports in this presentation. They are playing sports, they have an injury, which looks like a concussion. When they get up, they have no symptoms, you cannot see any signs. If you do your exam there is nothing that you can see, you are right, they are cleared to play. Then in an hour, half an hour, a few hours later the symptoms start kicking in.

This is where concussions can be problematic because we might be returning athletes to the field because we have done all the appropriate assessments and exams. Nothing is present on the exam. We will discuss the little nuances with that. The symptoms, usually, resolve within days, but may be prolonged. You are going to see the slides coming up. Basically, they will say, we expect most people to be able to go through the basic concussion recovery process. The concussion being there, inflammation, and metabolic cascade inside the brain. That process, can recover from that in about a week but they are now starting to show, through advanced studies, coming up in sentence 3 or 4, that this process may actually take up to probably 4 weeks, maybe up to 45 days. That idea of most people recover from that metabolic cascade within about a week, but they are starting to say that may be about a month.

No abnormality is seen on your standard structural neuroimaging, CTs, and standard MRIs, but in the research setting abnormalities may be present on our functional MRIs, Diffusion Tensor Imaging, Diffusion Tensor

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Tractography, PET scan, SPECT scan, and QAGs. What we are saying here is that they are starting to include some of these advanced imaging studies that use research because these have been starting to show, there are changes in the brain in a concussion, even though our standard imaging, CTs and MRIs, we normally use do not show anything. We are saying that there is no real structural problem but there appear to be functional problems that are occurring when we have a concussive injury.

Sport-Related Concussion result in a range of clinical symptoms and signs that may or may not involve the loss of consciousness. A general rule, there is only about 10% of people that have lost consciousness during a concussion, and 90% of concussion injuries do not lose consciousness. There are clinical symptoms and signs of concussion that cannot be explained solely by drugs, alcohol, medication use, or other injuries such as your neck or vestibular system or anxiety, depression, and other comorbidities. The clinical signs and symptoms cannot be explained solely by those things but you may have concurrencies. Someone may have depression or anxiety or a neck injury and then go and play sports and they go get the head injury and those previous symptoms can concurrently with that concussion injury. There's our current concurrent definition.

We want to go through and break all these down more in detail. Before we do that, we talked a couple of slides ago about they could not get to a consensus. Sport-Related Concussion has long endured the absence of a universally accepted definition, complicated by different terminology such as concussion, and mild traumatic brain injury. When you guys look through the literature, what you will see is the research that talks about concussions, and then you might see another research article that talks about Mild Traumatic Brain Injury (mTBI), and that mTBI research article is actually talking about concussions. They use the words interchangeably and this is what starts making confusion.

The actual Concussion in Sport Group in Amsterdam, they were trying to create a more universally accepted definition. As part of that, they recognized that the Concussion in Sport Group (CISG) recognize the American Congress of Rehabilitation Medicine (ACRM) that that group had a Mild Traumatic Brain Injury Task Force, and they were doing a similar thing. The consensus group, the Sports Group, they were trying to come up with an updated definition. The Concussion in Sport Group was trying to take the ACRM diagnostic criteria for an mTBI and they were trying to blend them in, the two groups trying to work together. I will talk about where the numbers went on the next slide. You can see there, this was taken from the Davis article, from one of the systematic reviews from the consensus meeting.

We have got now, the Sport-Related Concussion definition here on the left, which we just talked about in the last slide, they used the words there. Then we can see that the American Congress of Rehabilitation Medicine on the right side, they have their diagnostic criteria there for Mild Traumatic Brain Injury. You are going to see the similarities there, but then there are differences. The point that I really want to emphasize here is in the next slide.

Only 16 out of the 28 of the expert panel, not even 60% voted to incorporate the ACRM diagnostic criteria into the consensus. Remember we said, we have to get 80% to have a consensus agreement for the Concussion in Sport Group. The point of divergence was the scenario where an athlete with the biomechanically plausible mechanism of injury presents with acute symptoms of Sport-Related Concussion but no signs. The athlete has an injury and maybe they are saying, "I have a headache," or "I am dizzy," or whatever it is. They have one or more of the possible 22 symptoms that are considered to be the common symptoms of concussion. They have the symptoms but when you test them there are no signs. Their memory is okay, their neck is okay, their orientation is fine, their balance is fine. We will go all through this in seconds. There are no signs, there are no observable signs. They did not lose consciousness, they are not having seizures, and they do not have the staggers. There are no signs but they have symptoms.

It was recognized by the Concussion in Sport Group Expert panel that this a situation that the ACRM criteria classified the athlete with a suspected Mild Traumatic Brain Injury but the Concussion in Sport Group has

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consistently maintained that clinical signs of a concussion may frequently be absent and that in such cases the diagnosis of a Sport-Related Concussion can be established by the presence of symptoms alone. That is an important point, because when we look at the research the majority of concussion research, including in this consensus, the assessment and management, and clinical recovery, I used the word "clinical" importantly, which is based around symptoms. For you to have recovered from a concussion, it is about whether or not your symptoms have gone away. We also know that the more symptoms you have, and the more severe those symptoms are when you first had the head injury, the greater probability that you will have a prolonged recovery. The symptoms are still the number one driving thing as it relates to concussion and that is where I am going to ask our group to try to be better. I will explain why throughout this presentation, especially towards the second half of what we are doing here today.

The Concussion Pathophysiology, as we said, is the direct blow to the head, neck, or body that results in an impulsive force being transmitted to the brain. The yellow there is what I would like you to think is a concussion. In the red, think, that is my acceleration-deceleration mechanism. Yellow is what is a concussion, the inflammation in the brain. In the blue there, as we said, nothing is shown up in standard imaging but when we looked at the advanced imaging that is being used in the research setting, that is where we are starting to see the evidence of concussion functionally, and that is an important part. These are functional things where we are seeing different blood flow aspects, and different metabolic aspects in different areas. The advanced imaging which we cannot use as clinicians to refer and go say, "Can we get a DDT for assessment to see if this is a concussion or not." They are only using that in the research right now.

Here is the Neurometabolic Cascade of Concussion. This is still the model that is considered that is going on within the brain in 2014, this was where it was talked about. When I want to think about the mechanism, I have that acceleration-deceleration injury. As part of that acceleration-deceleration think about what happens to your neck. If that head goes forward, the back of the neck stretches and when I go backward the front of the neck stretches, or if it happens sideways.

I want you to think the same things are happening to your nervous system. Because the head sits on this 3D neck, when that acceleration occurs, because the head is on the neck there is generally an element of rotation that always occurs. As that occurs, we have these nerves that are stretching inside the nervous system. Now, think about wringing out a towel, if I wring out a towel, the water will come out in the middle of the towel. That is probably where we look at these advanced imaging aspects, we do see frontal lobe things, but we will see a lot of these midline pathways through the brain areas that are being affected. We will talk to you about what that essentially means for our assessment and management later.

For this perspective, for this cascade, when I get that stretching of the axons, you have the nodes around the area if you go back to your whole neuron anatomy physiology, you have different sodium, potassium pumps and all these gates that allow these ions to move in and out. These are usually regulated. You have plugs on them, you have gates that allow things to get in, but when you have that stretch, suddenly those gates just open and the ions start flooding in. What happens now is that the sodium starts flowing into the cell, and calcium flows into the cell and that is what creates action potentials. I have all these increased activities going on in the cell, especially once calcium starts getting in there, you are starting to release glutamate which is an axonal neurotransmitter, another side story.

Now we got a situation that your cells are firing like crazy but, in step 2 you can see there is an energy crisis. I will show you in the next slide in a graph what actually happens at the same time all of the ions are going into the cells while potassium is going out. The important one here is sodium and calcium are going in, which is activating the cell. Glutamate is released to the next cell. That cell is firing like crazy. Everything is firing the brain. The blood flow into your brain is decreased. We have decreased cerebral blood flow. What is the blood doing? It is bringing nutrition and it is bringing oxygen. This is your bread and butter for producing ATP. You need your glucose, you need your oxygen to be brought in in order to produce ATP. Why is that important?

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Because the ATP is the energy that you need, if you look at the picture there, it says the potassium pump. You need ATP to get those sodium, potassium pumps, to pump the sodium out of the cell and get potassium in, to get re-polarization of the nerve cell. But because you are losing that oxygen in the blood flow, you are losing the oxygen and the nutrition in the cell. What starts to happen is now you have an energy crisis. We have all these cells firing but we do not have the ATP to keep the balance, the re-polarization, getting things back in and out. Everything is just flooding in.

Now, because of all that stretching some of the advanced imaging is now showing that stretching might actually cause shearing and sometimes even complete "snapage". You might get this absolute separation of some of the pathways, or some of the axons can completely be separated. We get this non-continuity of the actual axons that sort out cytoskeletal damage, axonal dysfunction, altered neurotransmission, and inflammation and the cell can die. If you keep a cell going and you do not have that ATP coming into a cell, nerves can blow up from that. That is not good. That is the Neurometabolic cascade. If we look at it in a graft sense you can see the calcium is going in the cell, at the top in green. Potassium is coming in. What we can see at the very bottom in the blue or gray-blue is you can see that cerebral blood flow is down. You can see the percentage of normal there, it is nearly 50% of where it normally is. Look at those amounts, calcium is not good to have a bunch of that going into the cells because it creates toxicity. That is actually the thing you need to create, plasticity in the brain. You can see here how calcium, at that level, can potentially draw faulty plasticity.

We have cerebral blood flow being decreased there. Then when we look at the graph from the bottom and what they suggested is that this process normally takes, they used to say, about 10 to 14 days in adults to recover, you can see in this graph, it shows 10. They used to say it takes 4 weeks in children. They are now saying that this process can take up to 4 weeks. Most people tend to recover from their symptoms in about a week, but they are saying that this process may take up to 4 weeks, and that is because of what we are seeing in advanced imaging.

Go back a step to our definition, which talked about this Neurometabolic Cascade. We said that this here, on this slide, and on that previous slide, that this is what I want you to think a concussion is. When this process starts, that is a concussion. When all these chemicals and the blood flow and everything get back to normal, homeostasis, the concussion is over. The question starts becoming after that, what happens when people still have symptoms after that period? Now we are getting into a realm of different diagnoses, and a different conversation.

If we look at just the concussion, the metabolic cascade, the associated signs, and symptoms, as we can see there at the right. They are the 22 symptoms that are considered common in a concussion. This scale is the post-concussion symptom scale. This is the second step of our SCAT6 that we will be going through. This is where we write these symptoms. Headaches and dizziness are the most common symptom that tend to happen but you will also have other people who have a concussive injury and they talk to you about they feel like they are in a fog, they do not feel right, maybe a little confused, and maybe some fatigue. We can see here that these symptoms are very nonspecific. There are a lot of other conditions out there that can have symptoms like these. They are sensitive to light, and immediately what people would think of that, is a migraine. This is the way our thought process work.

The importance of the concussion is, I want us to be better than just these symptoms. As important as these symptoms are, I want us to be going better than this.

Clinicians and athletes can expect a minimum of 1 week to complete the full rehabilitation strategy. We will go through that towards the very end of the presentation. Based on what we are talking about, being able, in an ideal scenario, from injury to Return-to-sport, you can say a minimum of 1 week to be able to achieve that. Typical unrestricted Return-to-Sport can take up to a month. This is a big change from what was previously said.

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It was said that it would take 10 to 14 days normally in adults, and 4 weeks in children but now, they are saying typical Return-to-Sport takes up to a month post-Sport-Related Concussion.

The time frame for Return-to-Sport may vary based on individual characteristics, necessitating an individualized approach to clinical management. This is the part where I really want to emphasize here is, individualized nature. We will see that there is a lot of generalization. This is what we do from an exercise point of view, this is what we do from a generalized rehab point of view. We want to get good enough at our assessments that we can tailor how we are prescribing our exercises or our rehab strategies to that individual to hopefully, enhance better outcomes for that individual rather than trying to cookie-cutter some rehab protocol for every concussion. Then on the bottom there, you can see, 30% of adolescents experience persisting post-concussive symptoms beyond 1 month.

When we look at these persisting symptoms, the Amsterdam consensus recommended to include the use of the term "persisting symptoms". The words used to be in Berlin it was "persistent symptoms" or "persistent post-concussive symptoms". Whereas now they just refer to using the words, we now just have "persisting symptoms" and they do not use the idea of concussion in there. Persisting symptoms are to be used for symptoms that persist greater than 4 weeks across all age groups, children, adolescents, and adults. Again, it used to be, until this consensus made in these papers, it was said that adults would have 10 to 14 days. If you have symptoms lasting longer than that, that was considered persisting symptoms. Children and adolescents were considered 4 weeks, and if they had symptoms after it, that was considered persisting symptoms. Now, it is everyone. No matter what your age is persisting symptoms is if you have had a concussion and have not clinically recovered in 4 weeks you are said to have persisting symptoms.

Symptoms attributed to concussion are non-specific, as you have heard me say before, commonly also reported by healthy individuals, think like you had a bad sleep, light night. You wake up the next day you have a number of these symptoms just because of poor sleep. We can also have other conditions, other than concussion that could cause those symptoms, either migraine or depression. The other aspect is those other conditions can be exacerbated by the concussion or they can be exacerbated by biopsychosocial factors aside from the concussion.

All of these things need to be assessed in the context of persisting symptoms. Other problems may exist prior to injury that can be exacerbated by concussion co-occur with persisting symptoms or mimic persisting symptoms but do not arise from concussion.

A mouthful of writing but if we got this, here is a person at baseline, and that baseline, let us say, they have anxiety and they have migraine as well. They have anxiety and they have migraines. They now get hit with a concussion. They also have this stuff beforehand. They have whatever concussive symptoms that are going on, that concussion may exacerbate this, which is their anxiety or their migraines. The injury may exacerbate that or these things here may exacerbate these symptoms, and then, that period, that metabolic cascade, the concussion is now over but the person still saying that I have symptoms after this concussion. The question then becomes did the concussion injury create, when we will talk about these external changes, miscommunications, damage, et cetera to the different areas of the nervous system, it did that. Metabolic cascade, once that was over as part of the external injury, did that create problems that are creating the persisting symptoms or is it that the previous stuff that they have, the migraines and the anxiety, is that causing it? We can see the complexity of this.

I can tell you that when you got concussion patients and I see, unfortunately, I'm a little bit biased when it comes to this that is why I say I want everyone to be better because I see all the concussion cases that failed. All of my concussion cases are people who are months to years after having a head injury and they still have got persisting symptoms and could not get their life back. My bias is because that is what I see, so I want everyone to do a better job because we don't want to see people like this. But that part is one of the biggest

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things we spend time in my clinic educating patients about previous stuff, concussion, persisting, and how they interlink with each other, and it is an important education process especially when we are dealing with the biopsychosocial stuff, mental health, depression, anxiety, and have those things can be sensitizing this and vice versa.

A multimodal clinical assessment is indicated to characterize individuals with persisting symptoms, including the types, patterns, and severity of the symptoms. Of course, that is where we can just use that symptoms scale, plus some other scales as well that are out there. We will talk about them and any associated conditions and other factors that may be causing or contributing to the symptoms. Let us talk about it.

Mental health issues. We have to assess and discuss these things. History of these things maybe some patients reported the outcome measures to quantify those things. Learning and attention difficulties with these people like ADHD, dyslexia, et cetera. Visual, oculomotor, cervical, and vestibular problems. Visual processing or movement issues, neck issues, inner ear balance, reflex issues from ears to eyes, ears to spine. Headache disorders or migraine. Sleep disturbances, that is a huge one, we will get to that a bit later on. Dysautonomia, I'm going to get to that one later on because that is a bit exciting for me personally because of what the consensus group has brought in. Postural orthostatic tachycardia syndrome, orthostatic intolerance, as well as pain. When we look at these, that there, and I can suggest to you guys, there is actually a couple of more things in there that we should also be considering but that is your multimodal clinical assessment for someone who is coming in after concussion and they have got the symptoms still going after 4 weeks after the injury. We have to be doing all of that and more. That is a lot of stuff and if people are looking at that going, "Yeah, I want to be able to work in these concussion spaces but I don't have time in my clinic." One of my suggestions to you is, you either start creating new appointment types and charge for them accordingly, or you book these types of patients as the last patients of your shift so you can run overtime because you do not want to worry about your clock. You want to make sure that you get all the appropriate assessments done and to give you an idea, for me to do my physical assessment in the clinic, it takes me a bit over two hours or two-and-a-half hours to run through my complete assessment of someone with persisting symptoms after a concussion.

All right, the SCAT6. For the people who have got their ICSC, this would be the update for you guys to know where the differences are in the SCAT6. For the new FICS Sports Chiropractors who want to attain their ICSC, this section now is what we are going to need you to review this, and again, once you have done this section with me, maybe you want to review this. Just grab your SCAT6 hard copy, and download it free from Google, just type in SCAT6 and you will get a free PDF. Download that as a hard copy and start reviewing, working through it, and practicing it because when we get to the hands-on module, so for those that are coming to the Adelaide module here in Australia, that is about 3 to 4 weeks' time. I will be running through that hands-on module here and this material that we are doing now is assumed knowledge, it is a pre-requisite knowledge so when we get to the symposium, it is right where we are into the hands-on. None of these makes blinding how any of it works because it is assumed knowledge from this and we want you guys to practice this as many times as you can, leading to the hands-on because we will have instructors around the room assessing your ability to perform these tasks on each other. All right, here we go.

SCAT6 is endorsed by the International Concussion Symposium. These points are bolded here. This cannot be performed correctly in less than 10 to 15 minutes. These assessments cannot be done 3 minutes out on a pitch. Part of this is the concussion in Sport Group's attempt to try and get sporting organizations to change, I'm going to pick on soccer here because soccer has a time limit of how long a doctor has got on the field to assess an athlete and make a decision as whether or not to remove him from the field play. Why that is important in soccer because if you take an athlete off to assess them, that player cannot return to the field. This is the concussion in Sport Group's attempt to start, say, "Hey, in order to assess a concussion properly, you need at least 10 to 15 minutes. We got to have to make some rule changes within the sport in order to allow us to be able to do a proper assessment." That being proper I want to use the word maybe "the minimum standard

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assessment," this is the minimum standard. We can do more than this, but this is the minimum that we need to do and it is going to take a minimum of 10 to 15 minutes on the field and on the sideline to run through this to try and help you make a decision. The SCAT6 is designed for the acute phase. It is designed realistically to be used in the first 3 days and it can be used up to 7 days. But it starts losing its clinical utility in about 3 days and definitely after 7, but 3 days about that window with the exception of your symptom scale. That post-concussion symptoms scale, we keep using that as we said because the biggest predictor as well as the indicator of recovery, is this clinical recovery which is the symptoms that have resolved. If it is 7 days post-injury, we want to use the new SCOAT6, which is the Sport Concussion Office Assessment Tool and we will be touching base on that. That will be new for our ICSC current holders, and for all of the new attendees, this is going to be a brand new section that would be brought into this presentation and into the hands-on module.

The Child SCAT6 is for children aged 8 to 12. For an adolescent 13 or older, you use the Adult SCAT6 that we have on the previous page but if we are talking about 8 to 12, we are using the Child SCAT6. The same thing, cannot be performed correctly in less than 10 to 15 minutes, still the same thing with 72 hours up to 7 days. The thing that is a little bit different, and we have not gone through the SCAT6 yet but just sort of flagging it, where the child one is different is that symptom scale. You have the option to choose[?] well, that is so the children fill them in but you also have an option for the parent to then also fill in their child's symptoms, so, there are two symptom scales. One with the actual athlete child fills out himself and then we have the one that the parent fills out. When we get to the orientation questions, which is called the Standardized Assessment of Concussion, the orientation section does not exist in Child SCAT6. I will talk about that a bit more when we do the SCAT6 as well as the Maddocks questions.

The Maddocks questions do not exist in Child SCAT6. There is one part of the sideline test that they now do, which is new to the adult and the child. This was never in the SCAT5 but they are now using tandem gait and the difference with the child one is they put a complex tandem gait into the Child SCAT6. Where are the differences? They have two sets of questionnaires for reporting the symptoms in the child. There is no orientation, no Maddocks questions and they have the complex tandem gait in that SCAT6.

From our perspective, if we look at this from 13 years and up for adults, the diagnosis of concussion is a clinical determination made by a Health Care Professional (HCP), or Health Care Profession. SCAT6 should not be used by itself to make or exclude the diagnosis of concussion. As I said before, this is a minimum standard. The important point that you can see there is to note that an athlete may have a concussion, even if their SCAT6 assessment is within normal limits, and that is the point that we want to be able to do more. We want to be better than the minimum wherever we can.

Part one, again, from the learners attending the hands-on module. This will be part one of what we are going to be expected to work through and understand. This is the immediate assessment. You see an athlete get a suspected concussion injury on the field, so, you see a collision, you see someone down on the field, you are going out onto the field to perform an immediate assessment, neuro screen, and everything about this is basically think first-aid principles. Do we need to get this person transported to a hospital? We want to be thinking about this. When you are going out there, we are doing our whole Dr. ABC stuff. Some simple rules, if you see a collision, and you see someone go down, and they are unconscious, you think neck until proven otherwise. The whole process of if someone is wearing a helmet, we are not removing the helmet unless it is about airways, and then you have got to have the qualifications in order to do that. We are protecting the neck. We are not moving these people unless, again, it is for airway purposes. It is all about spinal and spinal cord injury prevention, so, the process of spinal boards, and we will do these emergency procedures through the FICS courses. But we have got first aid principles. If you see them get hit, and they go down and they are unconscious, you are always thinking about the neck and spinal cord injuries. But if you see someone go down away from play, they just go down and there is no one around them, you think cardiac. Some simple things here, even though this is a concussion course, we are healthcare providers, and you are assessing through and

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you might be running out on the field to look at an ACL or an inversion sprain or Charley horse. We have got all these different types of injuries, but obviously this one is specifically for concussion. You run out onto the field, you immediately assess and we are looking for our red flags, we'll go through those in a second.

There are 11 different red flags. If we see the red flags, are there any of those there, you can see they just follow the flowchart, remove from play, have an immediate medical assessment, or transport to Hospital Medical Center because we are worried about things like brain bleed, spinal cord injuries, et cetera. We do the red flags. If there are no red flags, then we move into the positive observable signs. We will go through those. If you see those signs, again, is the whole removed from play? Anytime you see the yes, it's removed from play, and we will think about medical assessment, transport to the hospital, and it's all depending upon the scenario that you are in as the health provider. Are you the only one there? Do you have the medical training to be able to be doing all those things? Well, you can say, "No, I'm not a medical provider. We are going to have to probably get an ambulance." Are you part of a medical team? If I am, let us say, working the surfing at Bells Beach, we have our water safety patrol that is out there on the jet skis in the water, we have a shark drone, we have our TV drone, we have then our emergency doctor down on the beach, we have an emergency nurse down on the beach, and then we have allied health up the top to go down and help if we need.

The medical doctor is at the top and it's this whole team process of knowing where obviously, we have got the water safety for obviously trying to prevent drownings and things like that, shark attacks if those things happen, and obviously shark spotting and getting athletes out of the water. Then we have got the injuries and then doctors, nurses, and team, and knowing what each of our roles is in each of those scenarios. If there was a head injury at Bells Beach, for example, our medical doctors would be running through this stuff first, and then I am there as part of that team to then to help in basically the next section, knowing where our roles are in each of those scenarios. You just work through this flowchart here and we are going to go through each of these things in a second. But if any of them is yes, it's the removal from play, thinking medical assessment, hospital transfer as required. If it's no, it's like no, no, no, no worked through, and we just continue to work through the SCAT. This is part one of the SCAT. This is you running out onto the field, and trying to assess immediately, and we are thinking all the bad stuff.

Box one, the red flags. Is there neck pain or tenderness upon that initial injury? We are worried about fractures and dislocations, those things, the bad stuff. Are they seizing or convulsing? Is there double-vision? If you see double vision, we are naturally starting to, the bad one that we're worrying about, is we got a blow and we have damage that is going to occur to obviously some of these cranial nerves that are occurring. We get someone that has an eye looking this way and this way. That is not how it is supposed to be. Our eyes should be yoked together.

Loss of consciousness. If someone has lost consciousness and we will talk about some of the other observable signs coming up. If they are unconscious on the ground, naturally, as we said, we are thinking neck if we see the blow. If it happened away from the field of play, the athlete has just gone out with a cardiac event. Someone has some weakness, tingling, or burning in more than one arm or in the legs, again, red flags.

Deteriorating conscious states. They have not lost consciousness, but you are watching them go in and out and are starting to become dazed, falling asleep, or these types of things. Not good.

Vomiting is the interesting one. If we look at some of the guidelines, you will see that some people say, if you vomit twice, then other people say one projectile vomiting, that is going to be a clinical judgment. But if you have gone out there, someone has had a blow, and they throw up straight away, you are removing them from the field of play for further medical assessment.

Severe increasing headache. Obviously, you are worrying about brain bleeds, intracranial pressures, and things like that. Increasingly restless, agitated, or combative. Glasgow Coma Scale less than 15. Obviously, from a red flags point of view, you can see here that you are performing the Glasgow Coma Scale to a degree because of a

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part of your observations. For those that are not familiar with it, we are going to be running through that. I have an attached video, that is actually a brilliant video. It does a better job than I'm going to be able to explain it. We will just share that with you. Then a visible deformity of the skull. If we see any of these red flags, removal from the field of play, medical assessment, and is it at a hospital transfer. There are clinical judgments to make.

Then our observable signs. We have done the red flags. If there are any of those, remove them from the field of play, where we go then, our medical process.

Next step, did you see someone lying motionless on the playing surface? Unconscious, falling unprotected to the surface. This is someone who gets hit and when you watch them go to the ground, they do not put their arms out to protect themselves, because falling unprotected means they are ragdoll, which means they got hit and they are unconscious now, and they are unconscious, falling to the ground unconscious. Of course, what happens then, they tend to hit their head again on the ground. The first two there are really about unconsciousness. You see these things; it is removed from the field of play. Balance gait difficulties, motor and coordination, ataxia, stumbling, and slow laboured movements, a simple way to view that point there, just picture someone drunk, staggering around. If you picture that in your mind, it is that type of stuff when somebody stands up and they collapse back down to the ground. They are staggering around, but they get up and you see their legs go on them, see them wobbling everywhere. They are the things that we are thinking about in that observation.

Then you have got your disorientation, confusion, staring, limited responsiveness, and inability to respond appropriately to questions. You will see, this is where we start to get into some of the Glasgow Coma Scale types of questions, our Maddocks type questions. You will see that there is interchangeability with some of these steps. But where did we see any of this blank or vacant look? That sometimes can be tricky. You must know the athlete sometimes to know, is it just how they look? Or, do you make a judgment call to go do that that looks like a vacant look? Facial injury after head trauma. Impacts seizures. That one is an interesting one so, for those that follow American football, or if you do not, Tom Savage's concussion that he had that was missed several years ago. He had an impact seizure that was missed. Jump up on YouTube, and type in Tom Savage's concussion. It is so subtle. It looks like a regular hit. He gets tackled and goes to the ground, nothing malicious. But if you carefully watch his right hand when he rolls over is having little seizures like this, and that was missed. That changed the NFL spotting concussion gameday guidelines. Impact seizures are now part of those observable signs and then it is at a higher risk mechanism of injury as someone fallen from jumping in the air and standing up on someone's shoulders and neck and they had fallen to the ground. This is in chiro racing activities. This is surfing and we are in a pipeline or choke, and we have some big 15-foot wave, and it's slamming the surface into the reef, underneath it. Did you get the idea? High-risk mechanism of injury. We are observing these things and when you see any of these things, we are moving them from the field of play. Medical assessment, transport to the hospital, making those clinical decisions, and what needs to occur there.

Now the Glasgow Coma Scale. As I said, this video is going to do a better job than me explaining it. I will put this on in a second. But as you can see, that is from the SCAT there on the left, our responses, our verbal responses, and our motor responses to get a Glasgow Coma Scale out of 15. If we see a score less than 15, it is removed from the field of play. Let us run through this Glasgow Coma Scale.

[music]

Sir Graham Teasdale: Current assessment of consciousness is often crucial in the care of a patient with an acute brain injury. This film will provide a practical guide to using the Coma Scale that we developed in Glasgow, to ensure reliable assessment and clear communication about the patient. We will show you how to make a series of standard observations of three aspects of the patient's responsiveness. Eye-opening, verbal, and motor responses for stimulation. Steps in each component can be rated according to defined criteria to show the

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degree of impairment present. We will show you how to record and communicate your findings, how these can be used, and provide you with a downloadable sample.

[music]

Narrator: When assessing a patient, there are four steps: Check, observe, stimulate, and rate. The preliminary check is used to identify any factors that might interfere with your assessment. It is important to identify local factors such as a hearing impairment that could cause a lack of capacity to respond. Following these preliminary checks, we observe the patient, noting any spontaneous behaviours in any of the three components of the scale: Eyes, verbal, or motor. The patient is rated in each component by matching findings with a corresponding criterion.

There are 4 criteria for eyes, 5 for verbal, and 6 for motor score. For each component, the top criterion is a normal response. Whilst the lowest criterion is no response. If the patient's eyes open spontaneously, spontaneous is recorded. Remember, there may be local factors such as swelling that prevent eye-opening. If the spontaneous opening is not demonstrated, a verbal stimulus is used by introducing yourself clearly and requesting eye-opening, if necessary, by shouting. If the patient opens their eyes, the sound is recorded. If the patient does not open their eyes when you speak to them, a physical peripheral stimulus is then applied. Stimulation starts at a low level by pressing on the nail tip and is applied with increasing intensity for up to 10 seconds until the patient demonstrates a response or until maximum stimulus has been applied. If the patient opens their eyes, record the pressure. If they do not open their eyes, record as none. If there are local factors such as swelling interfering with eye-opening, record eye is not testable.

To assess the verbal response, ask the patient to tell you their name, where they are, and what month it is. If answered correctly, record orientated. If during the conversation, the patient can speak in phrases or sentences but is unable to give the correct answers to these questions about orientation, record, confused. If they do not talk sensibly, or talk to single words, record words. If the patient moans and groans with no recognizable words, record sounds. If the patient makes no sense at all, then record none. Remember, speechlessness may result from factors other than depressed consciousness. For example, the presence of an endotracheal tube. In these cases, record, verbal is not testable.

To assess the motor component of the Coma Scale, first, ask the patient to perform a two-step action by asking them to grasp and release your fingers with their hand or opening their mouth and sticking out their tongue. If the patient does this, record, at base commands. If the person cannot move their arms, for example, because of a spinal injury, you should ask them to open their mouth and stick out their tongue. In a patient who does not obey commands, a peripheral stimulus alone is inadequate to assess the motor component to the Coma Scale, and an additional central stimulus is needed. This is first applied by the trapezius pinch. To perform this, place your hand over the patient's shoulder and press your fingers into the muscle above the shoulder blade. Apply pressure with increasing intensity for up to 10 seconds until you are sure that the response you observe is a patient's best response.

The second location for central stimulus is a super orbital notch. Apply this stimulus if there has been no localizing response to the trapezius pinch. This stimulus is applied by placing a hand on the forehead with a thumb over the upper rim the orbit feels for the notch in the supraorbital margin. Apply pressure with increasing intensity for up to 10 seconds until you observe the patient's best response. The patient should not be rated as having an absence of response until the maximum stimulus has been applied. This stimulus should not be used on patients with facial injuries adjacent to the supraorbital notch. If the patient moves their hand above their clavicle, or collarbone, in an attempt to move the stimulus away, record, localizing. If their upper limb does not reach the clavicle but does flex, then they are either normally or abnormally flexing. In clinical practice, the assessment of these non-localizing responses is based on a combination of both peripheral and central stimuli. In normal flexion, the elbow bends and the arm move rapidly away from the body and from the

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stimulus. In abnormal flexion, the elbow bends slowly and the arm comes across the body. If in doubt, record, normal flexion. If the patient extends their elbows rather than flexing them, record, extension. A patient who makes no responses is recorded as, none. If they are paralysed by other factors such as paralysis by drugs, record, motor not testable. If different responses are exhibited between limbs on the right and left sides, record the better side response as the best index of overall responsiveness. The response of the worst side may reflect focal brain damage or local injury.

To recap, check for factors that might interfere with your assessment. Observe the patient for spontaneous eye-opening, speech, and movement. If necessary, then stimulate the patient, first, verbally, and then physically. Findings should be documented clearly on a Coma Scale chart.

Brett: All right. As we can see this process there, we go through the idea of observing. Observing, obviously, is what we really want to see with our eyes, our verbal responses, and our motor responses. They are the things that we are hoping that we will see straight away. If not, we then have our sort of verbal aspects so that you did respond to the verbal stuff. Then, we have our palpation and pressure, pain generation stuff. The Glasgow Coma Scale, step one, when we go through this and the hands-on, you will have your SCAT with you. I will have this up on the presentation board. We will have all of these things there. You will work this through with a partner, working through and talking through those red flags. What it is that we are looking for, those observable signs talking what you are looking for, then you will go through the Glasgow Coma Scale. You could talk about how we can create a couple of different scenes during the hands-on module and score these things.

Then, step 3 will be a Cervical Spine Assessment. Now remember, this is immediate stuff happening out on the field. This is not like what we are doing in our office as chiropractors. It is just quickly going out there. Remember, as we said, if a patient is unconscious, as they can see here, or is not fully conscious, a cervical spine injury should be assumed, and spinal precautions taken. Does the athlete report neck pain at rest? Is there tenderness to palpation? Obviously, we are palpating spinous processes along those paraspinal muscles. If there is no neck pain and no tenderness, does the athlete have a full range of active pain-free motion? This is basically your myotomes and dermatomes, are they normal? They are going to be our quick on the field, neck assessment and again, if we see anything there, so if they go, "Yes, my neck hurts," let us remove them from the field of play for further medical assessment.

Step 4, your coordination, and ocular motor screens are basically just finger-to-nose with the eyes open, and then finger-to-nose with the eyes closed, and then we are going through standard cerebellar testing there. Do you see an intentional tremor? Do you see dysmetria, whether it is hypometric or hypermetric? Eyes open, or eyes closed, oculomotor stuff without moving their head looking side to side, up and down. The idea that we are looking to see, do both eyes move together? Are they yoked? Or do we see the situation where someone is moving from one side to the other and they are going like this instead of both eyes moving? Do they have double vision? When they are doing that, which is likely what would happen with that and can you observe whether the eyes are yoked properly, or whether we are seeing one eye not moving properly?

The standard ones are Maddocks questions that most people think about when running out onto the field. I'm going to ask you a few questions. Please listen carefully and give me your best effort. First, tell me what happened. The athlete is down, and then you are asking them the questions. Now, you got to think about the particular environment that you are in. Surfing is a different environment to what it is when we think about things like American football or basketball or Aussie rules football, rugby, or soccer. What venue are we at today? What half is it now? Who scored last in the match? What team did we play last week? Did your team win the last game? For certain sports, you will create sports-specific questions in place of those, but they are the classic five questions.

The 5 steps there, in the hands-on module, we will go through all of those, review those red flags, our observable signs, our Glasgow Coma Scale, the neck assessment, the coordination, oculomotor testing, and

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then our Maddocks questions. If we see any of those, remove them from the field of play, and throw the medical assessment. When the question comes up, if we are worrying about things, what about imaging? Well, we know with a head injury concussion is not going to show up in any of our structural imaging. In the research setting, if we talk about that, we may get those abnormalities with functional MRIs, DTTs, DTRs, PET, SPECT, et cetera. But our purpose for imaging is to exclude any red flag symptoms. We may refer for a CT straight away because you are concerned that there is a brain bleed, or you are concerned that there is a fracture. That is where the imaging role comes into play, which is that you ruling out a red flag. You are not referring to imaging to diagnose a concussion. Concussion diagnosis is a clinical thing. Imaging, again, is about the red flag aspects.

Some indications there for you, for imaging, we have the Canadian Cervical Spine guidelines, and we have the Canadian CT Head rule. We have our different factors there as to what would be considered indications for going and getting imaging after a potential cervical spine or a head injury. The point there on the right, though, is the advanced imaging is starting to suggest, this is again our functional MRIs or DTTs, PET, SPECS, advanced imaging, those things, is suggesting the brain is physically not recovering for greater than 30 days, and I said one recent paper suggesting 45 days. This is where some of the changes are occurring in the consensus definition. Advanced imaging, again, is used as part of the research to help these definitions and our understandings but for us as clinicians, we may want to be referring them based upon these guidelines in ruling out red flags based on your assessment on the field.

Once you have gone through the on-field assessment of the SCAT6, and those first 5 steps, basically, you are then going, well, I have made the decision that these obviously need further medical assessment or transport to the hospital. But if not, and you have suspected that there is a concussion injury, and there is none of those referrals for a medical assessment hospital, we are taking them off the field and we are then moving into the off-field assessment of the SCAT6. The first part was the immediate assessment, that neuro screen. That is part one of the SCAT6, and then part two is the off-field assessment. The recognition of concussions is the first step to initiating appropriate management. Removal of play from the field of play should be done if there is a suspicion of a potential concussion to avoid further potential injury.

The rules still exist to this day. If in doubt, sit them out. So, if you're in doubt, sit them out. It's a concussion.

It is better to be safe and monitoring and observing and continuing to do your serial testing than it is to return a player to the field. This may be based on the play symptoms or signs observed by other players, medical staff, or officials on the field or video and again, depending on the sports that you are involved with, we may have those video spotters that can obviously radio down and say, "We are going to get that athlete off the field." Obviously, in amateur or local sports, we may not have access to that but we may have a parent who sees something on iPad or phone because everyone's got a phone out now filming stuff. Signs that warrant immediate removal from the field include actual or suspected loss of consciousness, seizure, and tonic posturing ataxia to those observable signs. If you see those observable signs, it is an immediate removal from the field of play.

Our Maddocks' questions as we said accepting the children. We do not worry about those. Those five questions, what venue are we at? What half is it? Who scored last? Did you win your last game? Incorrect answers warrant a more comprehensive off-field evaluation as does any clinical suspicion or concussion. Symptoms and signs of a concussion may evolve over minutes, hours, or days. Whether acute concussion is suspected or confirmed, the player should be serially reevaluated in the coming hours and days. Recognizing it removing them from the field of play, and then performing the remaining parts of our SCAT and continuing to follow these athletes up.

The off-field assessment as we can see here, you have got basically the history part of it here. You have got the athlete background and we have got the symptom evaluation. The beautiful thing about the SCAT is you can see the blue italics there; it talks you through how to do each section. That is why I said review this but get out the SCAT and read it and start practicing doing it, and practice doing it, and the more you practice doing this

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the more efficient you will become at it and you will not necessarily need to be reading off of the SCAT. You just know what the next steps are each time. Filling in the data of the athlete's background, getting them to record their symptoms or scoring those symptoms like 22 possible symptoms and a total score out of 132.

Then we move into the Cognitive Screening. This is the standardized assessment of concussion, so we do our orientation questions. Again, this part is not in the Children's SCAT, but it is what month is it, what is the date today, what is the day of the week, what year is it, and what time is it right now so within the nearest hour. We are scoring that. Then we go through this immediate memory, and you can see there are three lists of 10. The old SCAT5 used to only have five-word lists and ten-word list options, but what they have now done is they have made it 10 to remove any ceiling effects, and when we look at the scope a little bit later, they have actually even provided 15-word options as well.

The way it works is that you basically say, "I am going to test your memory. I will read a list of words, and when I am done repeat back as many words as you can remember in any order." You might choose list A, list B, or list C. You can choose whichever one and you read each of the words at about one word per second. In this case, if I read off list A there, jacket, arrow, pepper, cotton, movie, dot, et cetera. After I've said the 10 words, then the patient is to recall as many as they can, and you obviously circle which ones they got correct or missed, and then you do three trials of this. I am going to repeat the same list. Repeat back as many words as you can remember in any order even if you said the word before, and you repeat that same list out again and you circle through the trials. You see, pretty straightforward.

Then we go to the concentration and then we got a similar type of process here with testing digits. You are going to use one of those lists of digits and you are going to give them, say, the first list A there you can see is 4-9-3. The patients got it, they will hear the words 4-9-3, but they have got to say it backward, that will be 3-9-4. Then you work your way through that list. Then you will go through the months in reverse order, but that is timed now. That is where that is a little bit different. You are going to get a stopwatch here. Their job is to do the months of the year backward and do it as quickly as possible. They want to see this basically no errors, so they get the months backward correct, so obviously December, November, and if they were then to go August, that is an error. They do not get a point, or if they can get it correctly all the way through from December to January but they cannot do that within 30 seconds, they do not a point for that either. This is going to become important because there is now a total cognitive screening assessment.

Then we do our Balance and Coordination Exam. M-BESS as you can see in the picture on the right there, the M-BESS is basically the top ABC. D, E, and F is the foam section, and that is optional because you must think about it you are on the sporting field, and having a bit of foam to test someone may not be available nor it may be not applicable in those situations. We do the M-BESS, we will go through this and the hands-on, of course, along with everything here. But the basic principles here you can see, it is hands on the hips, eyes closed, and it is about staying in those balanced positions. You are trying to stay there for 20 seconds, and we are counting the number of errors in each of those positions. What is an error? If you open your eyes, that is one error. If you take your hands off your hips, that is another error. If you stumble or fall out of the testing position, that is another error. If you stay out of the testing position, i.e. if you keep your eyes open for more than five seconds to recalibrate yourself, that is another error. Now, if you open your eyes and your hands come off your hips all at the same time, it is just one error. It is not all the errors together; it is just one. Now, when it comes to the M-BESS, if someone has made 5 errors in any of those positions, that is considered a failure.

With the M-BESS, after you have gone through that if they pass the M-BESS, you can then go to Time Tandem Gait. If they do not pass the M-BESS, then you do not have to worry about doing the Time Tandem Gait. Now, this Time Tandem Gait is new. Basically, you put a three-meter strip of tape on the ground, and the test is to get the person to walk heel to toe along that line, go all the way up to three meters, and then back, and you time that. They get three trials, and you get the average of those three trials. As you can see, the words, they are in

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blue. Please walk heel to toe quickly to the end of the tape, turn around, and come back as fast as you can without separating your feet or stepping off the line.

Then again, if they can do that, not falling over and not stumbling, et cetera, if they can do the three trials, then you can go to Dual-Task. All of this, it is the exact same test. They are walking heel to toe along that three-meter tape to the end and back. But while they are doing this, one of the common ones here that they were using this test is you are going to start at 100, and you are going to count backward by sevens. Now, what you do is give them a practice go at this first. Start at 100 and count backward by sevens. They are just sitting or standing, they are not moving yet, so 100, 93, 86, 79, 72, and they are doing that, right?

When they are working through that, you can see that there is your practice aspect there where they have got the score, so, you can see those and record them. If you are not good at math, you have got the answers there. Then you get them to do their three trials where you time it and you have also got those numbers there, but you will start them at different numbers so that way they are just not memorizing what the correct numbers are. You can see trial one, start at 88 and count backward by sevens. Now, why do we choose sevens? Because there is no pattern to it, all right? You have got to keep thinking because there is no pattern to the number seven. All the other numbers tend to have a pattern to it. That is the purpose of step 4. We do our M-BESS into our Time Tandem Gait. If you pass the M-BESS, then you go into the Dual-Task Tandem Gait optionally if you pass the Time Tandem Gait.

Then, the tricky part is then you say to the person, do you remember that list of words we gave you earlier? I want you to tell me back as many words as you can remember in any order. You do not give them any clues this time. They had three trials earlier before, but now you are seeing if they have got any of those words there in that delayed recall. You can see there on the bottom of the screen, you have got a total cognitive score there where you get to score all of those out of 50 now, and this is believed to have helped with the ceiling effect that occurs with the SCAT.

Again, when we get to the hands-on module, we are going to run through that first section there, all our immediate assessment neuro-screen, red flags, observable signs, Glasgow Coma Scale, the neck assessment, oculomotor coordination testing, and Maddocks' questions. Then after that, we will run through, and all of this you are going to have the SCAT in front of you, and you are going to just work through this. We will not worry about the hands-on, we are not going to worry about filling in the symptom score. We know that that is there, and you can have a look at that, but we will start to work through this standardized assessment of concussions. We will have a look at those practicing the orientation questions, going through obviously all of these immediate memory questions, our concentration questions, our balance coordination questions, and then this delayed recall.

Then the next step of the SCAT is then to come to a decision. Are you making a decision that this person has had a concussion? As you can see, you can fill in the SCAT there, and use this as part of your clinical assessment when you are working sideline, whether you are working in an office, and someone attends to you with an acute concussion, and this can help you come up with making that clinical decision.

The off-field assessment, typically the process conducting that screen to evaluate the concussion takes at least 10 to 15 minutes. Sporting organizations are strongly advised to allow for at least that amount of time for an adequate evaluation and to accommodate such an assessment off-field. We talked about that before with soccer. For athletes with a potential sign of concussion, any screening assessment short of a multimodal evaluation of symptoms, signs, balance gait, neuro, and cognitive changes associated with a potential concussion may be inadequate to allow continued sports participation. The idea of you walking out onto the field and doing this and flashing a light in people's eyes is just not good enough is what they are saying. If you are going to use that to make your call that someone is safe to go back, the consensus group is saying that is inadequate to allow continued sports participation. We have got to be able to do the SCAT6 as a minimum,

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knowing that is going to take 10 to 15 minutes if you are competent at performing it. Now sports whose rules currently do not facilitate such evaluation should strongly consider enacting rule changes in the interest of player welfare. The one we talked about again, of course, is soccer's the big one there.

The SCOAT6, again, is new. The SCOAT 6, for those that did their ICSC, is brand new. All right, for those that did this a couple of years ago, the SCOAT 6 is the new office assessment that they have created as part of this new consensus. For all the people trying to achieve their ICSC and this is the first time doing it, we are going to run through certain aspects of the SCOAT6 during the hands-on. Let us get into this. The purpose of the SCOAT6 was to give healthcare providers a standardized, expansive, and age-appropriate clinical guide to a multi-domain evaluation in the sub-acute phase. This is designed for after 72 hours. We do the SCAT first, and then if we are past 3 days to 7 days, we then start to use the SCOAT. Various components may assist the clinical assessment and guide individualized management. This is where we are starting to get into beyond the removal from the field of play and diagnosing a concussion, and now we are starting to look at this as okay, yeah, we have had the concussion and now we want to start to look at the various systems domains that may be involved in your injury and what things we need to do to help manage that. Now, again, it does not replace you as a practitioner, or your clinical acumen, but it provides a standardized framework that can be adapted to help inform your evaluation in your office. Again, the SCOAT6 is for 13 years and older and there is a Child SCOAT6 for children 12 years or younger.

SCOAT6, we have got very similar components to the SCAT. Step 1, you have got on the right side of the page there, we can see it gives you a structured way to help you take a concussion history or a concussion history. Not history for all your different types of injuries, but for specifically for concussion. It gives you that structure, the current injury, any history of head injuries, have you got a history of neurological, or psychological learning disorders. Then on the next page is what you will also see that then there is there any of those types of things within the family. They have got those there as well, which is obviously pretty interesting that we start to then bring in the family history component of some of those things. Then when we get into the symptom evaluation, that is the same as what you saw with the SCAT. We have got our post-concussion symptoms scale, our 22 symptoms. But then on top of it, they are also asking questions about your symptoms that they are bringing in autonomic nervous system questions. They are bringing in, do your symptoms get exacerbated by physical activity? Do those symptoms get exacerbated by cognitive activity?

Our verbal cognitive test is step three. They're the same as the SCAT6, so that is all of your standardized assessment of concussion, so your orientation, your immediate memory, your concentration aspects. But then this is where we get into some new stuff. The examination, now, the things that we have got here in bold, these are the things that I want to go through, obviously here today. But when we get to the hands-on and we do the actual practical aspects in the hands-on, we are going to be going through orthostatic vital signs, the complex tandem gait, and step 5, the modified VOMS. We are not going to be putting people on treadmills. We do not have enough time at the symposiums to do those and we do not have enough time to obviously go through the return-to-learn a return-to-sport. But I want to cover that here now, obviously, one, for the things that we are going to do with the hands-on and step 9 and 11, obviously, being very, very important components for the education and help management of athletes and people that have had potential concussion injuries.

Then you can see step 6, they have included an anxiety screen, which is the GAD, the Generalized Anxiety Disorder-7 questionnaire. The depression scale is two questions. That is a quick screen, and it suggests that if you get a certain score on that scale, which is a three, if you get a three on that scale, they are then telling you to then probably perform the Patient Health Questionnaire-9, so the PHQ-9, which is a more sensitive and more in-depth depression screening questionnaire. Then there is also a sleep screen. They are patient-reported outcome measures that are built into the scope.

Then you have got your delayed recall, just like the SCAT. Then if people are using impact or cog sport, that is just step 8. You just fill that in if you have been using computerized testing. Then our graded aerobic exercise

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test will go through that. Then it is like the SCAT6, we have got our overall assessment, management, follow-up plan, and discussing our return-to-learn and return-to-sports strategies.

Orthostatic Vital Signs. This was the new one that has been brought into the SCOAT6. Emerging evidence has associated concussion with changes in the autonomic nervous system. Postulated mechanisms include trauma to the hypothalamus, limbic cortex, midbrain nuclei, and regions of the brain responsible for autonomic function. Orthostatic tachycardia has been described as being associated with a substantial subset of concussion clinic patients.

Now, orthostatic, meaning, people who go from laying to standing, sitting to standing. Basically, when you get upright, we start to see that your heart rate spikes at least 30 beats per minute in adults, and 40 beats per minute in adolescents or younger, but their blood pressure does not change. We do not see the blood pressure drop. We see the blood pressure stay the same, laying down as it is standing, but we see their heart rate from laying to standing go up by 30 and there have to be associated signs with that, being, signs and/or symptoms, I should really say, light-headedness. They feel like they are going to faint, that presyncope feeling. Their vision gets like stars in it. They get spotty vision. You may see their hands and feet going blue or purple with that venous pooling. Temperature aspects, getting a headache, feeling nauseous. Legs feeling numb or weak. They have got to have light-headedness plus something else.

Now, this is a very specific area that I have a lot of interest in so I published an editorial and case series in this particular space. If you guys want to see that, just type in POTS, my name, and then Chiropractic Journal of Australia. It is a free PDF download where I go through the assessments and the relationships of a lot of these tests that we are about to talk about in the SCOAT and creating a multi-system, individualized management program and how, in my opinion, going after the dysautonomia first is very, very important in the management because that dysautonomia is all about cerebral perfusion. If I cannot keep blood into the brain, that was just like the concussion stuff we talked about before. It means I am getting less oxygen, and less nutrition in there, which means that my brain's not able to get ATP, so I am going to get different failures of different systems. If I am trying to rehab areas in my brain with whatever exercise I am doing if I've got dysautonomia, dysfunction of the autonomic nervous system, POTS is a form of dysautonomia, orthostatic intolerance is a form of dysautonomia. If I cannot keep that blood perfusing into the brain, then my rehab is potentially going to fatigue and fail because I do not have the energy systems. In my clinical opinion, this aspect is super important.

You can have a little bit further read into that space, but how do we perform it? Well, it is pretty simple. You have the person laying down on their back, blood pressure cuff on. A lot of the automated blood pressure cuffs now have blood pressure and heart rate so an automated one works really nice. Obviously, if you have got a manual one, you will have to have a manual one, plus you are going to be taking their heart rate as well. You lay them on their back for two minutes and they rest quietly. After two minutes, you take their blood pressure and heart rate and then you stand them up and then you are watching their heart rate, and then you are taking their blood pressure in a minute.

Now, that is how they are telling you to do it in the SCOAT6, in my opinion, that is not good enough. In order to assess this properly, now we are going to do it like the SCOAT6 when we get to the hands-on component. But for me to you clinically, as I said, I want you guys to be better, I want you to use the NASA Lean Test. Now what that is, you lay them down for two minutes still, and you take their blood pressure and heart rate. But when you stand them up, you stand them up and you put their backs against the wall, you have their feet out from the wall a little bit so that they are leaning on the wall, and then every minute for a minimum of five minutes, you are taking their blood pressure and heart rate, asking them about symptoms, just like you are in this one here from the SCOAT. Two minutes of laying, five minutes of standing, and every minute of blood pressure and heart rate. But then at the end of it, you then lay them back down, and after a minute to two minutes, you take their blood pressure and heart rate. Why this is important? Because of the actual diagnostic criteria for POTS, which is what you are assessing for here, in order to diagnose POTS, yes, you need to see that heart rate goes

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up by more than 30, and the blood pressure stays normal. But you need to lay them back down and you need to see that their heart rate returns back to normal and their symptoms resolve upon getting recumbent again.

We can see this is good that they have introduced it, it is just not good enough. Again, I want us to be better. We have got our criteria here. When we get to the hands-on module, I will have another little bit of a rant about that quickly, but we will just practice this version. Two minutes laying, one-minute standing, that is what is the minimum requirement, as we said, the minimum requirement in the SCOAT6.

Now the Complex Tandem Gait, we talked about tandem gait before, and we showed you how we will do that Time Tandem Gait, three minutes up, and then back time at three trials, get the average of the three trials. We then said we have got our dual-task version, so we do the same thing, start at 100, and count backward by sevens. This show that tandem gaits are validated and practical tests, and the evidence suggests that dual-tasking increases the sensitivity for concussion diagnosis. We went through that idea of the different dual-tasking, but the complex tandem gait, what is different about that, is once you have done the dual-tasking option, you have now got this complex version, which is just simply doing the tandem gait, but you are now going to walk forward, eyes open, and then you will do walking forward, eyes closed, and then you will do the same thing, walking backward, eyes open and eyes closed, but we just do that for five steps. As you can see there, you get scoring one point for each step off the line, one point for truncal sway, or holding onto an object for support.

We have got timed tandem gait, three meters up and back, three trials. We have got our dual-task version, still, the three meters up and back, timed, but that is when you are getting to do something cognitive, the hundreds by sevens, every second letter of the alphabet, months of the year backward, giving them words and getting to spell these words backward. Lots of things you can throw at them and a lot of those things are in the SCOAT there for you to use. Then you have got this complex tandem gait version, five steps forward, eyes open, five steps forward, eyes closed, five steps backward, eyes open, five steps backward, eyes closed.

The VOMS testing. Now personally, I thought and I had suggested for those people that had obviously attended the online module of this from last year and those that attended the hands-on last year. I really thought that this would have been included in the SCAT, what turns out it was, is that they could not come to a consensus, again that this should have been in the SCAT, but it is in the SCOAT6. Now the VOMS, they have modified it. As we can see here, symptom provocation with the VOR and the visual motion sensitivity tests appear to be associated with concussion. The modified VOMS has the same diagnostic accuracy and applicability as the original VOMS. It is important to recognize that if symptoms are reproduced during the VOMS, this does not rule in the presence of a vestibular or oculomotor problem.

The diagnostic accuracy of VOMS for concussion, my point that I have made before is I want us to be better, and the reason I want us to be better is because the things that they have taken out that I am about to show you here is you can see that the modified VOMS is we do smooth pursuits. We are going to go through each of these in a second, saccades, VOR, visual motion sensitivity. You can see the smooth pursuits, we do them horizontal and vertical. The saccades, we just do horizontal, but in the full VOMS, you do saccades back and forth, as well as up and down. But they have taken the up and down out. Now, what happened? You are not assessing for up and down. What happens if the concussions cause an up-and-down problem but you are not assessing for it? Okay, as I said, I want us to be better. In the SCOAT that says to do the modified VOMS, I would encourage everyone to also learn how to do the full VOMS. We will go through the SCOAT because that is the minimum standard that we expect everyone to know and that is what is been included from the research. But see if we can be better and add those other things. It is the same with the VOR. We have got a horizontal VOR, then we are doing this to a metronome at 180 beats per minute, but they have removed the vertical one. Then we got our visual motion sensitivity test, we will go through that, which is the same. But then they have also removed the near point convergence, which is basically bringing a bead of a focal point in towards the nose,

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and then you are measuring when that becomes a double vision, not blurry, but when it becomes a double vision, we measure the distance from the nose. They have removed that from the VOMS.

Here is the thing, the research suggests that 50% of concussions have a problem with this, with convergence, okay? Some of these things in here, great that they have been added, but again, as a group, I would like all of our sports chiropractors to go that step further and be assessing each of those things. The smooth pursuits, as we can see, we will go through this hands-on, but it is just following a target over two seconds side to side. I prefer around saying the distance, I prefer to move that target to the patient's shoulder width so that way, you know that you are doing it the same each time. Then when you do the vertical to the top of their head to the bottom of their chin, that way it is staying the same each time. Move it at a rate of two seconds so basically from one second from the middle to the out, which therefore means it is two seconds across, two repetitions in each direction and you are recording whether or not a headache, dizziness, nauseousness, foggy is aggravated from the test. Again, I want us to be better. I want you to also look at the eye movements and see if the eyes are jerky, or if are they following smoothly. During the hands-on module, we will go through those things and what that look like, and what that means.

Start practicing those things now. But really the VOMS from the SCOAT perspective is all about does it provoke symptoms. Does it provoke headache, dizziness, nauseousness, or foggy? Now, for horizontal saccades, again, I use the patient's shoulder width. They will talk about being one and a half feet to the right and one and a half feet to the left, so three feet. I like using that so it is standardized to that patient every time because do you know exactly where three feet are in the air unless you are like holding a string and you have practiced it and you know exactly where it is each time? I standardize it by keeping it to the patient's shoulder width. Back and forth, back and forth, back, back, back, forth, 10 repetitions in each direction. Does it aggravate symptoms of headache, dizziness, nauseousness, and foggy? But from our point of view, going that step further, do we see the eyes are accurate? Are they hitting the target the way they need to, or are they overshooting or undershooting? Or are they going to the eye and get hit to that eye? We want to observe all of those things because that means something.

The VOR, getting metronome out, and when we have that metronome going, a bit of a nasty one. We set this metronome to 180 beats per minute. They look at the target and in time to the beat. They are doing that horizontal VOR. After that, wait 10 seconds. Do they have headaches, dizziness, nauseousness, or foggy after that VOR? But you also want to look, were they able to keep their eyes on that target? Or when they turn their head, did their eyes move with their head and then come back to the target? Because that is going to mean something when it comes to time for our rehab. Yeah, we want to assess this for symptoms, but we want to also do it for our purpose of what might we have to do to help this person recover from their particular head injury.

The Vision Motion Sensitivity test is very similar in that we use a metronome, slower, 50 beats per minute. But what we then have the person do, I like having both hands together, thumb up, they are standing, they look at their thumb in time to the beat, they turn 80 degrees to one side, and they turn 80 degrees to the other side. The beat, hopefully, you can hear that. Looking like this, they would do five repetitions on each side, and wait 10 seconds. Headache, dizziness, nauseousness, and foggy, we are asking for those particular symptoms again.

It is important to emphasize that the VOMS was not designed as a comprehensive tool for vestibular and ocular motor function and may not encompass all the screening strategies necessary to examine all aspects of vestibular oculomotor dysfunction. Therefore, it may be useful as a screening tool, but it is not appropriate as a replacement for a comprehensive vestibular and oculomotor assessment. The point I am trying to make. That is not me saying that. That comes from a really great physical therapy, the American Physical Therapy Association paper that they did on concussions a couple of years ago. But what they are talking about there is exactly my point. How do we be better, okay? We have got the modified VOMS, great for putting that into the

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SCOAT and great for us using that to further assess our patients, but going that step further, what do those tests look like and mean? We will go through that more in that hands-on module. What do which of these tests look like? What does it mean? Because then that is important for our rehab. But then adding those old exercises that we talked about, the old tests back in that have been taken out of the modified VOMS, because that can mean something for us too. All right, going that step further.

The Greater Aerobic Exercise test. Arguably the thing that is got the most research for concussion management. When we look at exercise testing, it should be performed only when the athlete reports the general resting concussion symptom burden is not greater than a 7 out of 10. If they are sitting they are going, "Yeah, all right. Yeah, my headache sucks, but it is like a 6," or "My dizziness," whatever, you do not do the exercise testing on the treadmill until it is less than a 7 out of 10. Clinicians can prescribe targeted heart rate aerobic exercise treatment based on 90% of the individual's heart rate threshold at the more than mild symptom exacerbation point. I will show you how to do this test on the next slide. Basically, you are trying to figure out when the person becomes symptomatic or exhausted and whatever that point is of monitoring their heart rate throughout it. When they have a 3 out of 10 increase in whatever symptom it is, we stop the test and we get the 90% mark of whatever their heart rate was when that symptom went up to 3 out of 10. That is what the more than mild symptom exacerbation point means.

Then the sub-symptom threshold aerobic exercise treatment can be progressed systematically based on the determination of the new heart rate threshold on repeat exercise testing. You can keep going back to that treadmill test, keep repeating it every few days to every week, determine what the threshold is, and then have the person keep progressing with their aerobic exercise.

Prescribed sub-symptom threshold aerobic exercise within 2 to 10 days of having a concussion is effective for reducing the incidence of persisting symptoms. It is also effective for facilitating recovery and athletes suffering from symptoms lasting longer than one month. Why? Aerobic exercise enhances cerebral perfusion. It is helping blood get to the brain is one aspect of importance when it comes to that along with all the other things. But I want to talk really about that part there about making sure that we are getting that blood going to the brain. Using sub-symptom threshold aerobic exercise helps reduce the chance of getting persistent symptoms, but it is also going to help the people that have got persisting symptoms get better. Aerobic exercise is the message right now that we are going to make sure that we are all prescribing to our concussion patients and we want to assess and prescribe. But we can also understand now that if there is an inability to put people on a treadmill, there are also ways that we can start prescribing aerobic exercise in a very safe manner. This of course allows us to be very specific and safe because we can figure out the heart rate very specifically to work people out.

This here is how to do it, people. This is the one slide, so if you want to take a screenshot of this, take a photo of it. When I first started to learn how to do it, I literally had this as a printout page until I learned how to do it off the top of my head. You are basically setting the treadmill at 3.4 miles an hour or 5.5 kilometers an hour, treadmills at zero incline, and basically you are watching the person's heart rate and you are asking them about symptoms. We will just keep it that simple. They are walking away, walking away, and every minute you are increasing the incline by one degree, asking about symptoms while checking their heart rate, monitoring their heart rate with a pulse oximeter or chest strap or wristwatch, monitoring that heart rate, and each minute the incline gets up and up and up and up. Basically, you are going through the point if they can, where the treadmill maxes out on its incline, and when it maxes out on its incline if the person's symptoms have not increased by 3 out of 10 if the person's not complaining of feeling complete exhaustion, so their perceived exertion has not got to like a 9.5 out of 10, then we start increasing the speed. As you can see 0.4 miles an hour to 0.6 kilometres an hour, obviously is for the Australian to American conversion. Each minute, we start increasing the speed because the treadmill is maxed out, but we keep basically going with this test until the person's reached maximum exertion or they have an onset of new symptoms or exacerbation of symptoms of 3 out of 10 or the person talks about I do not feel safe. They cannot continue to do it safely.

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As soon as you terminate the test, whether it is the exertion, whether it is the symptoms, whether it is a safety thing, terminate the test and you record the final measurements of their heart rate. Whatever that heart rate is that you determine from the test, whether it was the 3 out of 10, whether it is the exertion, you take 90% of that heart rate and that is where we start our aerobic exercise treatment from. We will talk about that a little bit later, but that slide there, remember it, practice it, get the hang of that one. Again, in the SCOAT6, that's literally what's there. It says, Graded Aerobic Exercise Test and you put the protocol used. And there are a few different options that you got the Buffalo concussion treadmill test. You got the Buffalo concussion bike test. There are a couple of other different versions now where the University of Cincinnati is putting a stethoscope on and they are listening at the carotid artery and they are listening for bruits and they are obviously waiting until I hear the bruits and they are measuring what the heart rate is at that point in time. That is an interesting test that has been published too. There are a few different options that are out there.

This part here is not in the SCOAT6. Before we get into this section, sorry, for the hands-on module, we are going to go through the SCAT6, the immediate assessment neuro screen, and then we will be going to the off-field assessment, which is a lot of that cognitive and balance stuff. Then we are going to go into SCOAT6 hands-on and in the SCOAT6 hands-on component, we will go through orthostatic vital signs, complex tandem gait, and the VOMS. Practice those things and get printouts of SCAT6 and printouts of SCOAT6. Review this presentation, review those things, and then when we get to the hands-on module, we will be performing those things with most of it as assumed knowledge and me adding a couple of little nuances to the actual performance of the tests, okay? Really work with that over the next few weeks.

There is clear evidence to suggest that the cervical spine should be examined after a concussive event, but there is limited evidence on the examination procedures for cervical musculoskeletal dysfunction specific to patients who experienced the concussive event. Low-level evidence suggests that a concussive event can cause cervical injury and cervical musculoskeletal impairments can cause symptoms that are often reported after a concussive event. But when we look at SCAT6 and the SCOAT6, as it relates to the neck, the majority of the assessment base in there is just the on-field screening for the red flag stuff, so like fractures, dislocations, the bad stuff, spinal cord injury.

When we get to SCOAT6, still pretty similar. It is just that palpation really all that they add in is the specific ranges of motion. But from our point of view, again, going that step further, that next bit is better. What are some of the things in the research that we know that we can do? Because as we can see here, properly determining whether concussion or cervical injury is the source of symptoms is vital because the management of each condition differs considerably.

If you are going to sit there and go, "I'm a chiropractor, I treat the neck." But if someone has got a vestibular problem, driving a neck problem, we better understand how to assess that vestibular system. But vice versa if someone has got a selection of symptoms like headaches and things, and we need to differentiate whether that headache is coming from a Dysautonomia problem or whether or not that headache is coming from a Cervicogenic problem, we need to be able to differentiate those things. Then our profession, obviously being one of the better professions as it relates to manual therapy for treating cervical spine components, but we have got to understand the next step of being better at how we differentiate those things before we make those decisions over neck versus vestibular oculomotor, dysautonomia.

Different Forces, Different Systems. Julia Treleaven, obviously a great physio from the University of Queensland here does a lot of studies in that whiplash space. What she showed is when higher forces or a direct blow to the head occur, additional injuries such as concussion or damage to the central nervous system or visual or peripheral vestibular apparatus are more likely. Basically what we are saying here is if we look at the picture, the higher the forces that occur, the higher up we go. It takes less force to injure your neck but if we are getting more force and more speed that we are being hit, then the more likely are we to have the actual damage occurring higher up to the systems from neck to vestibular oculomotor, brain, et cetera because we can see

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that up to 35% of those with traumatic neck pain associated with high forces may have peripheral vestibular damage.

Someone that has got a chiro accident, 35% of those people may have a vestibular problem. We need to understand because chiropractors see whiplash stuff all the time. We need to understand how to differentiate a vestibular problem from a neck problem or how that happens concurrently and be treating them both. Injuries induced by axial rotation versus linear. Obviously, these types of injury fighters, punching, MMA, boxing, trying to rotate the head on the neck to try and knock someone out. Those axial rotation things may result in different types of neuro otological injury. But as you can see there that force is required. Nice little visualization there from Julia Treleaven, but that relationship between the nervous system and neck and from our perspective, understanding how to separate or concurrent components of having multiple injuries at once or differentiating so that we know which injury we actually need to be treating.

Great little test here, the Deep Neck Flexor Endurance test. A simple little test. Those two fingers under the head, get someone to perform a chin tuck, lift that head just off those two fingers, and hold that until fatigue or pain, all right? Basically, if the person's head touches that for more than a second, or you see that they lose the chin tuck, we stop the test. Some numbers that are out there, in general, talk about females should be able to last longer than 29 seconds, and men should be able to last longer than 39 seconds. If we are talking about athletes, we want our athletes to be able to hold this for longer than a minute. If they are an athlete that plays a sport that does wear a helmet, like American football, equestrian stuff, you get the idea, right? Lacrosse, any of these helmet-based sports, we would want them to be able to do that for a minute with their helmet on too.

One first test, then there is some evidence between the deep neck flexor endurance test and being able to go longer than a minute as a predictor of helping return to play. There is research out there suggesting that this one should be part of our return-to-play criteria. It is not part of the SCOAT. These ones I'm adding in now are additional bits of information for us, especially as chiropractors who have an interest in that neck. But I'm trying to just show you guys this next step of how we separate this from vestibular. We get to this one here, cervical joint position testing, put a laser on the head. You can get these targets off of the internet really easily now. There is one that comes as a PDF design so that you set it up 90 centimeters away. You sit on a chair 90 centimeters away from that laser and basically close their eyes with a laser in the middle of the target. They turn their head and I'm going to do this on purpose. They come back here and then it is checking where that laser is in relationship to the target.

Basically with that target, you can see there in the picture when they turn their head with their eyes closed and come back to the middle, they tell you when they think they are back in the middle, you mark that off. Then they keep their eyes closed, you reposition their head to where the middle was. Then they go to the other side and come back to the middle. They tell you when they think they are back in the middle, you mark that off and you position their head to wherever the middle is again. They go there and they are doing three on each side. Basically, if you look at that particular target there, if that red laser is outside of the yellow, they are greater than 4.5 degrees, that is where it said that they have got a cervical proprioception problem.

The idea is that they do not know where their neck is as a way to put it. They do not know where the head on their neck is or where their head is in relation to their body. However, that makes sense to you, but our cervical proprioception test, this one here very, very important as it relates, especially into the whiplash literature, but us integrating this for the next step of now we go. Well, what happens if we load the neck and we do some of those pursuits as we did there in the VOMS? Same thing, we do our pursuit testing and we are looking at the eyes now, are the eyes tracking smoothly? Then what we do is on the chair, as you can see in the picture there on the right-hand side of the screen, we then keep the head still and we get the person's trunk turned 30 to 45 degrees to one side, and then we do the pursuits again, and we are watching them follow. What we are primarily looking for is do the eyes get jerky, so they are not smooth. They are jumping, especially when they cross the

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midline. We do it this way and then we do it the other way. We are looking to see if there are differences in the eye movements from just straight ahead to when there is torsion, okay?

What the research has shown is that for patients with dizziness after a concussion, mild traumatic brain injury, who had an abnormal, laser on the head, cervical joint position testing, and Cervical Spine Proprioception is what the CSP stands for, Joint Position Areas, the JPE, and the SPNT is the Smooth Pursuit Neck Torsion test. If we have got someone who has got dizzy after a concussion and they were doing the head laser one, and that was abnormal, outside of 4.5 degrees or we did this one and when there was torsion, there was jerkiness, those people responded better to Cervical Spine Proprioceptive Rehab compared to Vestibular Rehab.

You hear the word dizzy and immediately people go, if you are dizzy, you got to do Vestibular Rehab. But if people had those neck-based proprioceptive problems, they did better by doing neck rehab. However, exclusion criteria included any patients who had clear peripheral vestibules. This idea if I went here and there was jerkiness, if you saw that there was jerkiness consistently with those types of testing, that would suggest more of a central type of problem, a central vestibular type of problem. If you saw nystagmus in someone's eyes, as a screen, if you did a Dix-Hallpike for BPPV, if we have got clear vestibular signs, we treat from a vestibular perspective. Those types of people got excluded from this study to allow us to narrow down the actual neck component. But if you see nystagmus, if you see consistent psychotic intrusions in this Smooth Pursuit Neck Torsion test, if you do a Dix-Hallpike and they have got obviously BPPV things, you go after the vestibular system. That comes from that particular paper there again, everything referenced there for you guys. Understanding the pathophysiology of concussion proves, especially critical for the 20% to 30% of concussed patients who develop persistent post-concussion symptoms.

I know I have done another presentation online for FICS, where I start talking about these reticular formations and the way that those different pathways integrate. Understanding the pathophysiology is really, really important for these people that don't recover in that normal four-week period. We want to try and make sure that we are better at our neuroscience, our assessments at our management strategies to try and help these people who are not recovering.

Awesome 2 slides we have here. Referral to clinicians with specialized knowledge and skills in concussion management should be considered for the targeted treatment of persisting symptoms. This is straight out of the consensus paper. Referral to clinicians with specialized knowledge and skills in concussion management. Now, it is super important if you are going to be working with concussion patients, you need to be current with concussion literature assessment management strategies. You cannot know a concussion from 5 years ago. The research is changing too quickly. You have got to be current with it to be able to help assess and manage symptoms. But the exciting bit is what the Sport-Related Concussion clinician network may include, put it in bold, this is for the first time in history that the word chiropractor has been listed in this network, and specifically, it is sports chiropractors. We are considered part of the network if we have got the knowledge and skills. At FICS this is part of developing those skills and I'm asking everyone to try and be better than what it is that we are presenting here for you at FICS. We want to go to that next step, the next level.

From the consensus paper, our role in the management because we are now recognized as part of that clinician network for the first time. Our role is the assessment of the athlete, it is the SCAT6 and the SCOT6. That is number one, it is the assessment first, recognizing it, removing it from the field of play, and doing all the appropriate tests. Now, depending on the sports chiropractor's competency and expertise, Cervicovestibular rehab for dizziness, neck pain, or headaches in people that have had symptoms for more than 10 days. This is the words out of the consensus statement. Vestibular rehab or Cervicovestibular rehab for dizziness-balance problems. If you have got the competency and the expertise in those areas, this is obviously the stuff that the consensus group is saying, "Yeah, the sports chiro is good for this." The prescription of that sub-symptom threshold aerobic exercise and the implementation of our return-to-learn and return-to-sports strategies. It is

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a very exciting time to have our names in the consensus statement and these are those things according to our competencies and expertise that we can have a role in as part of that clinician network.

The rest of the exercise part. I am going to go through these things at a pretty good clip. You will obviously have the recording of these things. This is the additional information that the take-home messages. I am really going to emphasise the stuff in bold.

Relative rest, 1 to 2 days max of rest after a concussion is all it is now. There is no more cocooning. There is no more rest until your symptoms go away. Relative rest, basically immediately first 2 days after injury, we were allowed to rest. Actually resting from screens at that time too, get off your phones, get off your computers, and TVs, basically. Do cognitive stuff, thinking, reading, like paper-based things, some homework, those types of things, activities of daily living, it is okay to start building and introducing those. We will go through the specifics of that in return-to-learn. But once the 1 to 2 days are over, stop resting. We have got to start doing stuff. It is recommended after 24 to 48 hours to return to physical activity, that is the PA. Physical Activity is tolerated. Prescribing sub-symptom threshold, aerobic exercise treatment within 2 to 10 days after the concussion. The big emphasis here is relative rest for 1 to 2 days. Getting people to do physical activity is tolerated. What does that look like? Well, here is our return-to-learn and return-to-sports stuff.

The Return-to-Learn. This is so important for the children. The emphasis is getting kids back to school, not back to sports. We will use aerobic exercise to help them in their return-to-learn but it is not about getting them to sport until they can do this return-to-learn strategies. You can see here, progression through the return-to-learn strategy is symptom limited. Basically, you just look at step 1, step 2, step 3, step 4. You are just doing those things 2 out of 10 is fine. You hit a 3 out of 10, stop. If this is a person who has got a headache, light sensitivity, whatever it is, start doing some of those gradual activities of daily living. Just the normal reading you might do. Minimizing your screen time at step 1, though. Step 2, maybe start doing some work at home or some of the homework you are supposed to do, not in the classroom, no. Just doing some of that homework, 3 out of 10 seems like if your headache or light sensitivity increases by a 3 out of 10, that is the end of that, got to wait till it is gone, okay?

You just basically going to work through each of these based on your symptom-limited capacity. Again, as we said, student-athletes should complete a full return-to-learn before unrestricted return-to-sport. Now as part of this, the relationship between you as the healthcare provider and the schools becomes very, very important as part of maybe there is going to be some academic requirements that are needed to put in place, i.e. handing assignments in a little bit later, allowing extra time for examinations, testing, et cetera, depending on when a head injury might happen as to what is happening in that curriculum for that student in their particular school at that time.

Now Return-to-Sport Strategy. As we talked about expect a minimum of one week to return to full return-to-sport, but typically unrestricted return-to-sport can take up to one month. Now, when we look at these, it is guided again, step by step. Everything here as we progress through this idea of it is okay to have symptoms, one to two, increase out of 10, increase by 3 out of 10, the session is over. There is that basic rule. You can see step 1, symptom limit activities, just do your daily activities that do not exacerbate your symptoms. Then in step 2, this is done without doing the treadmill test. This is just saying, "Hey, you can start doing up to 55% of your max heart rate as long as the symptoms stay in that mild range, one or two, hit a three, and the session is done." Then you can progress to the moderate 70% of your max heart rate, 1 or 2 out of 10 is fine, not allowed to get to a three if the session is over, then you can start moving into the sports-specific stuff.

At this point here in the middle of steps 4 to 6, you can start moving into the sports-specific things once there are no symptoms. All right, this person is going to be symptom-free. There is SCAT testing of cognitive function, concentration, delayed recall, all of those numbers' backward orientation, all of those things, cognitive function, and any other clinical findings they had. The M-BESS, dual-tasking, whatever you found in your SCAT6/SCOAT6,

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all of those signs that were related to that person's injury, they need to have been resolved. Their symptoms need to have been resolved and then when they are doing their physical activity you can see in steps 2 and 3, during the physical activity and after the physical activity that they cannot have any of their signs or symptoms at all. Before they can get to step 4, they have basically got to have a clinical resolution, symptom resolution and all of their signs have been resolved and that includes when they are doing physical activity. Basically, each of these steps is considered to be 24 hours, and if you cannot do step 1 or step 2 without the symptoms, you have got to stay at that level until such time that you can move until you can do stage 2 without the symptom exacerbation, then you can move to step 3.

Again, the consensus statement and the SCAT6 have obviously all of this with all of your further details in there, but nice, easy step-wise progression. I'm just saying, here is the concussion, here is the education on getting people back to learning and back to the sport. That process there, a step-wise process from the consensus statement. The newer things that they have started putting in the consensus statement this year is this section called the Reduce. The consensus statement created like the 11 hours where the idea of recognizing the concussion, removing from the field of play, I will use the word re-evaluate just to keep the hours there. They had this whole section there like rehabilitation, return-to-sport, return-to-learn, but what they have added this year is this idea of the Reduce. How do we prevent concussions? Because prevention is better than cure. What some of the research has shown the consensus statement has now included is to say rule changes have helped reduce concussions.

Disallowing body checking in children and adolescents ice hocking has reduced the rate of concussions in games. Policy and rule change is going to be a big thing moving forward for a lot of sports and they showed in American football, the limiting the number and duration of contact practices, the intensity of contracting practices, all of those collision-based things, reducing the amount of that that occurs in practice has had an overall reduction by 64% in practice related concussions and to reduce head impact rates. Policy changes are very, very important.

Now, Mouthguards. This has always been an interesting one because the mouthguard stuff has been, "Does it help, Does not help." Mouthguards were associated with a 28% reduced concussion rate in ice hockey across all age groups. Mouthguards are being encouraged now as part of that prevention strategy, obviously, as well as the whole teeth strategy.

Neuromuscular Training Warm-up programs are completed at least three times per week. It is been associated with lower rates of concussion in rugby union across all age groups. Just think of our FIFA 11-type programs for these neuromuscular programs. These types of things here as part of a warm-up shown to help reduce concussions. So far we have got policy changes in the sport, wearing a mouthguard, doing a neuromuscular warm-up, and then of course, all of the management strategies, the idea of our role in this is being able to recognize it and remove the player is mandatory from sports. If we see it, the mandatory removed from sport and they then got to get clearance from a healthcare provider in order to return to play. They just cannot say anymore, "Yeah, I'm good to go," and now they have got to have clearance. Having coaches educated about it, not pushing athletes back out. They are going, "Oh, that is my best athlete and I need them to win the game." They go, "No, the health and well-being of my athlete is the number one priority, not the game." Educating parents about concussions, and educating the athletes themselves about the concussion signs and symptoms, but all of that whole management protocol has been associated with a reduction in recurrent concussion rates. Having a concussion and then getting that second concussion or third concussion or whatever it might be. Reducing the recurrence.

The next one that they brought in was the reconsider the long-term potential effects. This is the one that is getting all the media attention. This is the area that got all the negativity that is driving this sort of concussion message and making concussion very, very topical all over the world, but especially around the US and the NFL, ice hockey, it is obviously starting to come into Australia here now with the AFL and rugby. We had our first

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female ever diagnosed with CT and she is in her 20s that just happened. This stuff is obviously full-on in the media here at the moment in Australia and obviously continues to be a worldwide thing.

There is increasing concern about possible problems with later in-life brain health in former athletes such as mental health problems, cognitive impairment, and neurological diseases. Previously what was known as survey studies. This is important to understand what type of studies we are talking about here. Because of the consensus statement, they used cohort case-controlled studies. That is what they looked at in this systematic review. It is very different from these ones and it is important to understand the different types of studies. As a result, you get different types of results. Survey studies said that some former contact and collision sport athletes report difficulties with cognitive function and mental health.

Cross-sectional studies. Former contact and collision sports athletes have identified changes in brain structure, physiology, and biochem. Some death certificate studies of professional soccer players, particularly Scotland and American-style football players have reported associations between ALS, Lou Gehrig's disease, and dementia as causes of death that was previously known.

When they did the consensus statement and looked at their systematic review, cohort studies, these case-control studies. Former amateur athletes are not at an increased risk for depression or suicidality in that type of study. Professional soccer players are not at risk for psychiatric hospitalization. Former professional American football and soccer players are not at increased risk for mortality from psychiatric disorders or suicide. Men who participated in amateur sports are not at increased risk for cognitive impairment, neurological disorders, or neurodegenerative diseases compared to men from the general population. Men who participated in professional sports, however, have reported an association with neurological diseases, eg, ALS and dementia. In professional football players, American style, as well as soccer players. But the consensus statement did not identify any published case-controlled or cohort studies. This is what they were looking at in their systematic reviews are very, very specific.

They could not find any case-control or cohort studies that examined the age of the first exposure to a head impact and later-in-life health risks. They did not find any of those studies that use neuroimaging as an outcome. They did not find any studies that examined later-in-life risks for women. They did not identify any of those studies were considered post-mortem cohort studies for CTE. Of course, that is the big topic is the CTE stuff. Everything that we have got right now is all the brain bank stuff. Of course, the challenge with that as an area, is the people who are donating their brains to these brain banks are generally people who have played sports and have got those concerns. We are going to definitely, therefore, see a bias in potentially seeing these CTE types of neural, neuropathological changes. It is tricky.

So what the consensus statement is saying is what we need to help better identify these things are case-control and cohort studies. We need more of these longitudinal studies. That is what we need. Any of the researchers out there that have got an interest in this space, that is what is being sort of put out there that we need this to help answer these questions better to go, are there concerns for us? Long-term effects? Do we really need to know what these numbers and percentages are?

Then, of course, the new one now, of course, is when should we retire after concussions? There is no clear evidence of the factors that, if present, would unequivocally lead to retirement. They have not been able to collect what these factors are to say, "Yes, you need to retire." Basically, the conversation is a complex one. It is multifaceted. It needs to involve clinicians with expertise in traumatic brain injury, and concussion. They need to have expertise in sports. We need to have neurologists, sports physicians, psychologists, and sports chiro. We need to have that multidisciplinary team and the athlete and their families having this conversation. I personally have been involved in this conversation with three of our high-profile athletes here in Australia about retirement. It is a tough one. It is a tough conversation to have, and it is a collective input from multiple sources

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so they can make the best-informed decision for themselves cause we do not have any specific evidence that says this is when you have to retire, this is the data we know, we are going to collect more of it.

But here is the important part. Given the positive benefits of exercise on health, all athletes who ultimately retire from contact or collision sports should be encouraged to continue noncontact or low-contact physical activity. The importance of continuing to exercise, even though it may not be contact or collision sports.

Obviously, we are not time for any questions here because it is not interactive, but if you do have any questions, feel free to reach out to FICS, to get any of those afforded over to me. Any of the Australian cohorts will be in Adelaide, feel free to obviously ask me, we will go through all of these things in their hands-on.

To all the people that are attending the Adelaide symposium, print out the SCAT, print out the SCOAT6. Start reviewing this presentation, work your way through the SCAT6, the SCOAT6 hard copy, and practice those tests. Again, we are going to do the entire SCAT6, the immediate assessment neuro scan screen that we are going to be doing hands-on. We are then going to be doing the off-field part of SCAT6. We are doing all of that hands-on and then we will be doing those specific components of SCOAT6: Orthostatic vital signs, the complex tandem gait, and the modified VOMS.

Please, when you are attending these hands-on symposiums, bring a hard copy of the SCAT that you can complete. Bring at least the one-meter tape measure so that we can do our time tandem gaits. We can obviously get three meters out on the floor. Bring a metronome on your smartphone, and bring a blood pressure cuff and heart rate monitor. Obviously, an automated one often comes with both, but if you have got a manual, bring some form of heart rate monitor, a pulse oximeter, something to wear, a chest strap, or a wrist strap. Obviously bringing a timer that you will need on your smartphone as well.

Just making sure that we have got all of those tools that we are able to utilize when we are doing those hands-on and keep in mind, again, all the FICS-ICSC practitioners have to update their head injury module every 2 years. For those that are currently needing to get updated, this will form that new update for you guys this year. Obviously, for the people next year, they will have their new one references. All are available for you here at the end of this presentation. You can go and look up all of those, but the majority of the information that I have presented to you here today is taken from these current 10 systematic reviews and the consensus statement.

I hope that you have been able to take some of these things out here for our ability to assess people on-field to then be able to make decisions about recognizing, removing from the field of play, off-field assessment, in-office assessment, starting to understand what some of these further testing and understanding that pathophysiology relationship between the autonomic nervous system with orthostatic intolerance, exercise testing, using exercise for recovery, vestibular oculomotor testing, neck, how to separate some of these with some of those tests.

Appreciate everyone's attendance for this.

If anyone has got any questions, please feel free to reach out to me via FICS. Thank you very much.

[END]